

ANCHYLOSIS

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BRODHURST



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with the Author's kind regards

ON ANCHYLOSIS.



# ON ANCHYLOSIS,

AND THE

TREATMENT FOR THE REMOVAL OF DEFORMITY  
AND THE RESTORATION OF MOBILITY IN  
VARIOUS JOINTS.

BY

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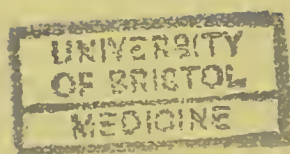
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## CONTENTS.

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	PAGE
INTRODUCTION . . . . .	V
CHAPTER I.	
PATHOLOGY . . . . .	1
CHAPTER II.	
FIBROUS, OR FALSE ANCHYLOSIS . . . . .	18
CHAPTER III.	
DIAGNOSIS . . . . .	24
CHAPTER IV.	
TREATMENT OF FALSE ANCHYLOSIS . . . . .	28
CHAPTER V.	
BONY ANCHYLOSIS . . . . .	82
CHAPTER VI.	
TREATMENT OF BONY ANCHYLOSIS . . . . .	85



## INTRODUCTION.

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TWENTY-FOUR years ago I brought the subject of forcible flexion of ankylosed joints under the notice of the profession, when a communication, together with a series of cases, was published in the 'Medico-Chirurgical Transactions.' It was there shown that mobility might be restored to limbs which previously had been considered to be hopelessly stiff—that fibrous ankylosis of the hip-joint, for instance, resulting from gonorrhœal rheumatism, which had been hitherto deemed irremediable, was amenable to treatment. The treatment which had been employed in the cases which were brought before the Society, and which was recommended for adoption, consisted of immediate flexion of the limb, together with subsequent gradual extension.

Prior to this, gradual extension had been alone employed. Such treatment was found, however, to be entirely nugatory. I have known instances in which this so-called treatment had been continued for years—even for ten years—without alteration in the position of the limb.

It was further shown that the limb being slung, as in Fig. 1, p. 46, and when the patient was under the influence of an anæsthetic, a slight jerk in flexing the limb, the

hand alone being used to impart motion, was sufficient to destroy any adhesions and to restore mobility. The same mode of treatment was also advocated for other joints similarly affected.

In immediate flexion of the limb injury cannot accrue to other structures, as in forcible extension of the limb.

The report of the discussion which followed the reading of this paper on the evening of March 24th, 1857, sufficiently indicates that credence would scarcely have been accorded to the statements which were made had not the patient mentioned in Case 6 been present in the room. His narrative, corroborated by those who were present at the operation, confirmed what had been written. Yet, some years later, Sir William Fergusson expressed extreme surprise on witnessing a similar operation, and as these pages are passing through the press not less surprise was expressed by many who were present at an operation of an exactly similar character.

Therefore it is that after more extended experience I desire to confirm all that has been previously said, and to express my increased confidence in these operations. More than one thousand operations of this description enable me to speak of them as among the most successful in the whole range of surgery. I have never known inflammation to follow such an operation, nor have I ever experienced in any case fracture, neither rupture of any vessel, nor, indeed, an accident of any kind. It would seem impossible that the force employed should act on any other structure than on the adhesions only, in flexion of the limb.



The adhesions in ankylosis of the hip cannot, except when they are quite recent, be ruptured in extension of the limb, nor can they be affected in the slightest degree by gradual extension. It was on this account that Sir Benjamin Brodie, when he was consulted with regard to the patient referred to in Case 6, said, "that he must take his stiff joint with him to the grave." Such was the rule until adhesions were ruptured in flexing the limb. Now, it is my lot very frequently to see cases where a futile effort has been made to liberate a joint, either because extension has been made instead of flexion, or for some other reason; and where, in consequence, a faulty diagnosis has been pronounced.

Dr. Little<sup>1</sup> writes of forcible extension of the hip-joint thus:—"We may mention, in illustration of the comparative difficulty of straightening the hip, that, in an instance of uniform fibrous and vascular membranous adhesion of the head of the femur within the acetabulum after death, the partially ankylosed pelvis and thigh having been removed from the body, we were unable to extend the hip by any power we could exert with our hands until the capsular ligament and some of the adhesions within the acetabulum had been severed with the knife."

During the week in which I write these pages two cases have come under my care, to which I will briefly allude. One was that of a young lady, eighteen years of age, who seven years previously was chloroformed, and a prolonged attempt was made to overcome the stiffness of the hip-joint, and to set it free. In this, however, the surgeon—

<sup>1</sup> 'A System of Surgery,' by T. Holmes, p. 718, vol. iii.

and I may mention that there is not any one in the profession better known in the metropolis—was foiled ; and he was so satisfied since his attempt had failed that nothing could be done, that he laid the strictest injunctions on her father never to allow any further attempt to be made to regain mobility. At eighteen, however, the patient herself was exceedingly anxious to know if this decision was to be final.

It was not necessary to employ an anæsthetic to feel assured that the joint might be set free, for it was almost done in making the preliminary examination. It was done instantly when unconsciousness had been produced. Thus, what had been impossible in extension of the limb was easy, even seven years later, in flexion.

The second case was that of a young lady, sixteen years of age, in whom inflammation had been set up in the hip-joint two years before I saw her. Ten days before I saw her a consultation had been held, and it was recommended that the neck of the femur should be divided. On the day following that on which I was consulted she was put under the influence of ether, and although the adhesions were strong they gave way easily, and the limb was immediately free. In one week all the movements of the limb could be performed, and she could bear her weight on the foot. There was no shortening of the limb. In this case the adductors were remarkably rigid before the operation, and, therefore, although there was scarcely the slightest movement at the hip to be obtained, it was certain that the adhesions were fibrous.

I am able to add, at the expiration of three weeks, that

there is only very slight difference in the power of the two limbs, and that there is the same freedom at the hip-joints alike in both.

I seldom use a bandage except to retain a splint, and never for longer than forty-eight hours. And the splint which is most convenient is one that can be readily moulded in the room, and which can be altered as needed. It is always in the first instance applied at the same angle as before the operation. A splint is seldom necessary for the hip. Weights and pulleys may be at once used to steady the limb; and when tenderness has subsided, in from forty-eight hours to four days, gentle movements will tend to restore the power of the limb.





# ON ANCHYLOSIS.

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## CHAPTER I.

### PATHOLOGY.

ANCHYLOSIS is that condition of a joint in which adhesions have formed, or new material has been deposited within or external to the synovial membrane, and through which motion is in part or wholly lost. This difference, namely, complete or partial loss of motion, has given rise to distinct terms, which imply more or less the conditions of the parts involved in the disease. Thus, ankylosis is said to be true or false: true ankylosis, or synostosis being bony union of the articular surfaces, the soft structures in the interior of the joint and the cartilaginous coverings of the extremities of the bones having been removed; while false ankylosis is occasioned by membranous or fibrous adhesions within or around a joint, and which interfere more or less with freedom of motion. Muscular contraction alone, resulting from fracture, for instance, may occasion entire loss of motion. This is very rare, however, and quite exceptional. Muscular contraction, impeding the motion of the joint, as it is ordinarily seen, and without adhesions, is not now understood as ankylosis.<sup>1</sup> True, complete, or bony ankylosis, or synostosis, then, signifies complete loss of motion in the affected joint; and false, partial, or fibrous ankylosis, implies that motion is impaired, but not wholly lost.

<sup>1</sup> Ankylosis, from ἀγκύλος crooked. Thus, Celsus, "Contractos articulos, quas ἀγκύλας, Græci nominant,"—Lib. v.

Further, anchylosis, whether true or false, may be straight or angular, and simple or compound, *i.e.* complicated with dislocation. This complication with partial or complete dislocation is not rare : it occurs especially after the formation of abscess. Some authors have included unreduced dislocations in their consideration of compound anchylosis. This subject is, however, worthy of separate consideration, and will not be specially considered here.

Every articulation is capable of undergoing bony anchylosis. Some joints, however, are much more liable to this alteration than others ; and, indeed, it may be looked upon as a natural change in certain parts of the skeleton in old age. Thus, it is not uncommon to find that, in advanced age, the ribs are firmly consolidated by osseous matter together with the vertebræ, and the vertebræ one to another ; and, less frequently, the various bones of the carpus are found in the same manner united, as well as those of the tarsus ; and, also, the sterno-clavicular, and some other articulations. This change may be considered as incident to age ; the diminished secretion of synovia probably giving rise to structural disease and removal of the articular cartilages, as has been suggested by Rokitsansky. Also, anchylosis is observed in the aged, as the result of chronic rheumatism. And, wherever undue pressure has been long continued, as, for instance, in old curvatures of the spine, deposits of bone (bridge-like formations and osteophytes), are formed at the margins of the bodies of the vertebræ, and union of their surfaces takes place ; in wry-neck, firm bony union may result between the atlas and the axis ; and in club-foot (in advanced age), the same is occasionally, though rarely, observed between the various bones constituting the tarsus, and especially between the calcaneum, the cuboid, and the fifth metatarsal bones. Whenever anchylosis takes place in the mixed form of articulations (amphiarthroses), it is bony union that occurs. In these articulations, the natural movements are so slight that they would scarcely be diminished by false anchylosis.

In the movable articulations (diarthroses), both forms of ankylosis—true and false—are observed, but, while true ankylosis is more frequently found in ginglymoid joints, it is much more rare in enarthrodial (ball-and-socket) articulations. Especially is it uncommon in the shoulder-joint, and in that of the jaw.

Besides those causes already mentioned, there are others which tend to produce ankylosis; such as inflammation of the structures within the joint, whether rheumatic, syphilitic, scrofulous or gouty, traumatic inflammation, and that arising from sprains, contusions, or other mechanical injuries. Also, it may occur as a sequence of deep burns, of phlegmonous erysipelas, of gangrene, and of extensive ulceration. Fracture, also, extending into a joint or occurring in the immediate neighbourhood of a joint may determine complete loss of motion. Again, ankylosis is occasionally observed as a congenital affection. It is then, doubtless, the result of inflammation, equally as when it occurs after birth. The articular apparatus is then entirely absent.

True ankylosis, or synostosis, then, may be induced by any of these causes. Ankylosis of the movable articulations is always the result of inflammation; consolidation—true ankylosis taking place or fibrous adhesions being formed.

The causes of false ankylosis are every variety of inflammation through which lymph is deposited within or external to the capsule, so as to form adhesions which shall interfere with the free motion of the joint. Adhesions within the capsule are termed “intra-capsular,” and those which are formed external to the capsule are known as “extra-capsular.”

Some forms of inflammation attack especially the structures external to the articulation, while others affect by preference those within the joint. Consequently, the character of the inflammation being known, it may be premised, with more or less certainty, what is the situation

of the adhesions—whether they are intra- or extra-capsular.

In a large number of cases, the diagnosis may be made with sufficient accuracy, the form of the previous inflammation being considered together with the alteration in the shape of the affected joint and the character of the impediment itself. There are, however, numerous cases in which it is impossible to determine whether the adhesions are intra- or extra-capsular, until the patient is under the influence of chloroform, and force is being applied. Then, when they are being ruptured, it is not difficult to determine both the position and the extent of the adhesions.

Intra-capsular partial ankylosis results from synovitis—acute, subacute, or chronic; whether of a rheumatic, syphilitic or strumous character; and extra-capsular ankylosis depends perhaps rather on gonorrhœal rheumatism, phlegmonous erysipelas, strumous abscesses, and mechanical injuries. There are, however, numerous exceptions to this statement. Extra-capsular adhesions, also, frequently exist together with others within the joint. When extra-capsular adhesions are alone referred to, it is to be understood that the synovial membrane is unaffected, and free from adhesions.

Although it is not my intention to enter upon an inquiry into the diseases of joints in their primary stages, but rather to limit my remarks to the results of such diseases, and to the treatment to be adopted for the removal of the impediments to free motion which have thus been produced, it will be necessary to make some few preliminary observations.

No period of life is exempt from these affections of joints, but the liability to suffer from their several varieties is not alike at all ages. Thus, we find, that childhood is especially obnoxious to strumous affections, and that primary synovial inflammations are comparatively rare at this period. Again, in adults, inflammation of the synovial membranes may be said to constitute the rule, all other



forms of inflammation being then comparatively rarely met with.

The commencement of disease is here alone referred to ; for, as the synovial membrane may become implicated in disease which has had its origin in other textures, so inflammation, having commenced in the synovial membrane, may proceed to affect every portion of the articulation.

Of intra-articular inflammations some are especially prone to the formation of adhesions, and terminate without involving or only partially involving adjacent structures, while others occasion thickening of the synovial membrane, softening of the ligaments, and displacement of the bones. I will, therefore, describe in some detail the distinguishing points of these several forms of inflammation.

Synovitis may be acute, subacute, or chronic, and it may arise from a local cause. Also, it may be modified, as by rheumatism, scrofula, and syphilis, according to individual diathesis. The inflammatory product is effused into the articulation, bands of lymph are formed between adjacent portions of synovial membrane, which become organised, and act as impediments to motion.

These adhesions do not impede the motions of the joints in proportion to their extent, however, as might *à priori* be supposed ; but, on the contrary, a very slender band may entirely prevent voluntary motion, while with more extensive adhesions there may be freer motion.

Acute synovitis commences with pain, which is soon followed by heat and swelling. The synovial membrane becomes congested, and the natural secretion is poured out in excess. Distension of the capsule may become so great that the sense of fluctuation, which was distinct, is perhaps lost. Fluctuation is to be distinguished most readily in the joint which is least covered ; as, for instance, the knee-joint. Here, by the side of the extensor tendon and of the ligamentum patellæ, the fluid protrudes the synovial sac into the spaces between the tendons and the ligaments. The membrane loses its glistening appearance

and becomes thickened and softened. Flakes of fibrin are found floating in the serous fluid, and, also, adherent to the membrane itself; and these deposits, connecting adjacent portions of the synovial membrane, become partially organised, and constitute bands of adhesion.

Subacute synovitis is the commonest form of inflammation. It rarely runs on to suppuration; but it is apt to assume a chronic form. Lymph is effused, which forms membranous adhesions.

Chronic synovitis frequently gives rise to loss of mobility. The synovial secretion is poured out in increased quantity, and is of a more aqueous quality than in health; and it causes great distension of the capsule and extension of the ligaments of the joint. This distension of the joint leaves, when absorption of the effused fluid has taken place, a relaxed condition of the ligaments; and, thus, the flexor muscles, when the knee has been affected, may displace the articular extremity of the tibia backwards. The flexor muscles are, for the most part, more powerful than the extensors; and thus in disease a flexed position of the limb is usually seen both during the continuance of disease and after it has subsided. But, also, a partially flexed position allows of the greatest distension of the joint with the least amount of pain; for in this position is found the greatest relaxation of the lateral ligaments of the joint. When, on the other hand, the leg is fully extended, the lateral and the crucial ligaments so tightly fix the limb as not to allow either of lateral or of rotatory movements; and the thigh bone is then pressed into firm contact with the leg bones. After disease has subsided the flexor tendons remain tense and the muscles contracted.

Thus, fibrinous deposits take place within and, also, external to the synovial membrane; and the membrane becomes more or less thickened through interstitial deposit of lymph; and the articulation is consequently found enlarged, and its motion is impaired.

No joint causes more trouble than the knee when it

becomes inflamed. It is less painful than the hip when inflamed, its capsule being less resisting; but, on account of its large and complicated synovial surface, it is more liable to inflammation than any other joint, and the effects of inflammation are frequently disastrous.

These forms of inflammation may be modified by rheumatism, syphilis or scrofula, which, affecting an articulation, become local manifestations of a constitutional disorder.

Rheumatic synovitis is attended with severe pain. Inflammation commences for the most part in the structures external to the articulation, and it rapidly involves the joint itself: effusion into the synovial sac takes place, and lymph is ultimately deposited on either or both surfaces of the synovial membrane. This form of inflammation usually commences external to the articulation, being confined to the ligamentous and other fibrous structures, and it may not invade the joint itself. The inflammatory product is poured out into the cellular tissue around the joint, giving rise to induration with thickening and consolidation of the soft structures into and about which it is effused. It is not uncommon to find that the cellular and fibrous tissues around the articulation alone have suffered from the inflammatory deposit, the synovial membrane remaining unaffected and clear, and the interior of the joint free from the effects of inflammation.

The knee more frequently suffers from this form of inflammation than any other joint, being more exposed to vicissitudes of temperature than any other large joint: it is less covered by muscle, and less protected artificially.

Rheumatic inflammation, when it assumes a chronic character, "chronic rheumatic arthritis," as it has been termed by Dr. Smith, of Dublin, may induce, by the formation of ossific growths between and upon the articular surfaces, and by alteration in the shape of the articular surfaces themselves, more or less immobility. Slight increase of synovial secretion is followed in the later stages of the affection by exostotic growths, which, encroaching on the articulation, seriously impair its



mobility. Dr. Robert Adams, of Dublin,<sup>1</sup> has shown that true bony ankylosis is an exceedingly rare result of this form of disease; but that articular rigidity, or false ankylosis, is not an unusual consequence.

Scrofulous disease occurs in a morbid condition of the system, which has been induced, perhaps, by insufficient nourishment and by exposure to cold, or it results as a sequel of measles, smallpox, scarlet fever, or other exhausting malady. Such a condition being developed, scrofulous disease may be set up by a kick or a sprain, or a fall, or from so slight an accident that it might almost be said to arise without a local cause.

Scrofulous disease of the joints usually commences in the articular extremity of the bone in childhood, and then proceeds to involve the soft structures of the joint. This affection is very common among children: there is none more frequently met with. Articular ostitis commences in the cancellous structure of the extremity of the bone, and ankylosis may take place even without the formation of abscess. Such a course, however, in this form of disease is rare. When the disease terminates without suppuration being established, mobility may not unfrequently be restored; and even this has been known to take place when a portion of cartilage has been removed. Not uncommonly, the course of this affection is as follows:—Slight pain and swelling are at first experienced, which may or may not subside, leaving, however, more or less tenderness and weakness of the affected joint. At every attempt to use the limb, puffiness about the joint will be observed, and this, as well as the pain, will be sensibly increased by any unusual exertion. Abscess will form and discharge itself; the ligaments will become softened and extended, and the limb will be flexed.

In this form of inflammation the synovial membrane becomes much altered in structure, being thickened and softened, with deposits of curdy lymph upon it, and the

<sup>1</sup> 'A Treatise on Rheumatic Gout.



joint becomes disorganised. Again, displacement of the articular surfaces of the bones may take place with fibrous adhesions ; or bony ankylosis may form.

But, after suppuration and the removal of necrosed bone from the joint recovery of mobility, after breaking down adhesions, may result. Such a case came under my care at St. George's Hospital. This patient was fourteen years of age, and when six yearsold he received a kick on the knee. There had been suppuration ; but when admitted into the hospital there was only a slightly weeping wound, which, being explored, disclosed a large piece of necrosed bone lying behind the joint. The knee was bent at a right angle. The sinus was enlarged, and a large piece of bone, evidently a portion of the head of the tibia was removed. Subsequently, and when the wound had healed, the flexor tendons were divided, some adhesions within the joint having previously been ruptured. The boy left the hospital, having regained the use of the knee-joint, his foot being slightly raised by means of a thickened sole.

Syphilitic synovitis partakes of the characters of both of the above-mentioned forms of inflammation—rheumatic and scrofulous—according to the period of development of the constitutional disease itself. When it occurs in secondary syphilis, it assumes somewhat of a rheumatic character, the fibrous structures being at this period of the constitutional malady especially affected ; while in tertiary syphilis inflammation assumes somewhat of a scrofulous character, the tendency of syphilis itself being at this time to resemble scrofula. Thus are formed adhesions which may be intra- or extra-capsular ; or the joint may become disorganised, and, the cartilage being removed, bony ankylosis may result.

In extra-capsular ankylosis adhesions are formed external to the joint through various forms of inflammation. The fibrinous exudation is deposited in the cellular tissue external to the joint ; it becomes consolidated, and immobility of the surrounding parts is produced. The

exudation is poured out between the muscles and tendons, and they are thus bound together, and the articulation becomes motionless.

There is a form of inflammation, namely, gonorrhœal rheumatism, where exudation may be confined to the exterior of the capsule, or, on the other hand, effusion into, with great distension of, the capsule may occur.

This inflammation is rheumatic synovitis of a peculiar character, which is preceded or accompanied by urethral inflammation or irritation. Such an affection will be recognised by every practical surgeon.

It is to be regretted that the term "gonorrhœal rheumatism" was ever used. It was adopted in error, on the supposition that this affection of the joints was necessarily consequent on gonorrhœa virulenta.

It is true that this affection of the joints is usually preceded by gonorrhœa, but it is not absolutely necessary that the disease should be preceded or accompanied by urethral discharge. Sir Benjamin Brodie has shown that the use of the bougie may induce "gonorrhœal rheumatism."<sup>1</sup> I will narrate a case, the most remarkable of its kind that I have seen or heard of, where there were four attacks of inflammation, but the last was not preceded by a purulent discharge.

Usually, however, the course of the disease is as it is stated above, namely, that urethral discharge precedes inflammation of the synovial membranes. And not only is it usual that there shall be urethral discharge, but this is generally of a specific character. However, it is clear that this rheumatic affection of the joints may follow any form of urethral discharge.

"Gonorrhœal rheumatism" perhaps never occurs for the first time without urethral discharge, and this is generally of a specific character; but a second attack may occur without urethral discharge.

Such being the case, the term "gonorrhœal rheuma-

<sup>1</sup> 'Pathological and Surgical Observations on the Diseases of the Joints,' 1850.

tism" is not quite correct, and may lead to erroneous conclusions. The term "urethral rheumatism" might, therefore, advantageously be substituted for it.<sup>1</sup>

The pain attending this form of inflammation is of a most acute character, and the effusion about the joint is often very considerable; so much so, indeed, that great tension of the integument may be induced. Suppuration, however, never takes place. The fibrinous material is poured out into the cellular tissue around the joint, and, this consolidating, the articulation becomes fixed. Mobility is impaired in proportion to the intensity of the inflammation, and the consequent deposit of lymph: it may be entirely or only partially hindered. I have seen a great number of ankylosed hip-joints from this form of disease; and in every instance, the limb has been fully extended. In two or three instances, there has not been appreciable motion, even under chloroform, but there remained elasticity only, showing that union was not bony. In others, the smallest amount of motion—just appreciable motion—remained. I have never seen a case where the hip was ankylosed in a flexed position from this form of inflammation—the position which is almost always assumed in other forms of inflammation of the hip-joint.

In other joints a flexed position is that which is most commonly met with, a certain amount of motion, perhaps, remaining. For instance, the limb may be semi-flexed; beyond which extension may be impossible, but further flexion may be perfect. Some years ago I saw such a case with Sir William Gull; and I allude to it here, for it illustrates well a condition that is not unfrequently seen as a result of this form of inflammation. On attempting to extend the limb, the obstruction was so complete that it was believed by some who had examined the case that the exudation was osseous, so suddenly and harshly

<sup>1</sup> The term "urethral rheumatism," which was proposed by Dr. Elliotson, is perhaps more truthful and presents other advantages over that of "gonorrhœal rheumatism." With one exception, however, the specific character of the urethral discharge has been acknowledged in every instance of "gonorrhœal rheumatism" with which I have met.



was extension of the limb stopped. It was determined to extend the limb, using a moderate amount of muscular force; and, this failing, that the tendons should be divided. As much force was used as seemed to be justifiable, but without success. Then the tendons were divided, and, with a very moderate amount of pressure, the adhesions instantly yielded; and thenceforth the joint was perfectly free.

The following case is the most remarkable of its kind that I have seen. I introduce it here, for it illustrates several points of interest in this malady. And I may premise that I do so, for this form of inflammation occasions more frequently than any other false ankylosis.

In October, 1859, a gentleman wrote to me, requesting me to go to him; at the same time excusing himself, being, as he said, so great a cripple that he could not come to me. When I saw him, he related the following history.

In 1848, when he was twenty-five years of age, he had intercourse of a doubtful character, which was followed in seven days by urethral discharge. Some few days later, synovitis of both knee-joints supervened, with considerable pain, followed by effusion. He was confined to the house during two or three weeks, and was then again able to walk about, before, however, the swelling about the knees had quite subsided. The urethral discharge continued for two months, and then ceased. Before three months had elapsed, he had entirely regained the use of his knees. At the expiration of another period of three months, the act of intercourse was repeated, under similar circumstances as before.

The urethral discharge again appeared on the seventh day, and it continued for two months. It was followed, in the course of a few days, by synovitis of the left hip-joint, of both ankle-joints, and of the tarsal-joints (the soles of the feet were not affected). Now, the pain was more acute than on the previous occasion, and the swelling and rigidity also lasted longer; but after ten months he was

again able to walk with the aid of sticks. The stiffness of the limbs continued yet for many months; but at length he entirely regained the use of the affected joints.

In November, 1852, on the occasion of the Duke of Wellington's funeral, rain coming on he took refuge in a doorway, and temptation was again offered which he did not resist. Again, a similar series of events, such as has been described as occurring on two previous occasions, followed without any material or notable difference in the commencement. On this occasion, however, both hip-joints became inflamed, as well as both ankles and one knee. This attack of inflammation was much worse than the previous one.

On perceiving the urethral discharge, he immediately consulted a gentleman eminent as a surgeon, whose foible it may be said to be to ignore gonorrhœal rheumatism. And on this occasion, also, he ignored it.

Notwithstanding, synovitis appeared at the same period as before. Pain was excessive; and the effusion around the joints was greater than on any previous occasion. He was long in recovering the use of the limbs. Yet he recovered; but with this exception that, having been seated for some hours, his limbs became somewhat stiff, and he had difficulty in rising from his chair. This stiffness continued, and he never lost it. On this occasion, for the first time, he suffered from ophthalmia.

Here, then, are three distinct attacks of inflammation of the joints recorded as following close upon specific urethral discharge. The most extraordinary part of this story yet, however, remains to be told.

Having suffered so much he determined never to expose himself to similar influences again, and therefore being in good health, with the exception of the rigidity of the limbs, which has been already noted, he married in the year 1854. The consummation of marriage appeared to him to be impossible. He accused himself, however, and painful efforts were repeated. At length it was discovered that the consummation of marriage was impos-



sible. Dr. Lever was consulted and found that complete occlusion of the vagina had taken place.

At this time, namely, immediately after marriage, articular inflammation recurred; and it recurred with redoubled violence. Now it recommenced to cease only with life itself; or when every articulation had become ankylosed. On this occasion there was no urethral discharge.

The same quality of inflammation of the articulations was induced as on previous occasions; but now it terminated in ankylosis.

I found that ankylosis had taken place of the atlas together with the axis, and that all the cervical and most of the dorsal vertebræ were ankylosed together. The hip-joints were also ankylosed, and entirely motionless. The head was thus immovably fixed; and the hips being fixed, the knees were the only portions of his body which would bend "to shorten him," as he expressed it. But this was not all. Ankylosis subsequently took place of the temporo-maxillary articulations, of the shoulder-joints, and of the knees, the ankles, the feet, the elbows, the wrists, and the fingers. In fact, before death released him every joint in the body had become ankylosed. He was unable to move his body in the slightest degree. I never saw an object more truly pitiable, whether from his helplessness or on account of the pain which he suffered. The wine of colchicum and morphia combined, and in large doses, gave him some relief.

Here, then, is an affection which is always preceded by urethral irritation, and, for the most part, by a specific urethral discharge. The discharge shows itself later than gonorrhœa virulenta, for the most part, appears, and it lasts longer. Further, when the disease has once been established, it may be reproduced without urethral discharge. No form of inflammation induces false ankylosis so frequently as this.

Again, strumous abscess occurring in the neighbourhood of a joint, occasioned perhaps by the diseased shaft

of a long bone, may burrow and surround the joint. Lymph is deposited in the cellular tissue, and thickening and adhesions result. The abscess having discharged its contents, cicatrices form, and contraction of the limb probably follows. More or less immobility of the articulation is thus produced, with, probably, some displacement of the articular ends of the bones.

Phlegmonous erysipelas, involving the cellular tissue, quickly proceeds to suppuration and sloughing. The purulent matter burrows in the course of the muscles, causing separation of these one from the other, with destruction of the intermuscular tissue and fasciæ. And the joints themselves are not exempt, but may equally undergo destructive inflammation. This form of inflammation usually, however, runs a rapid course, and terminates without affecting the interior of the joint; it occasions sloughing of the cellular tissue, and consequent contraction of the surrounding parts, with loss of mobility in the neighbouring joints. Also, diffuse cellular inflammation, consequent on dissection wounds, will equally induce ankylosis. Such was the case with a leading Russian physician, from St. Petersburg, who lately came under my care. The middle joint of the ring-finger of his right hand was ankylosed at a right angle.

Mechanical injury causes perhaps more frequently true than false ankylosis. Inflammation may, however, be set up in the neighbourhood of a joint which shall terminate in false ankylosis, or it may give rise to muscular retraction, through which the power of motion shall be destroyed.

Articular disease has thus been shown to commence ordinarily in the bone or in the synovial membrane. The cartilages, therefore, become implicated secondarily. When inflammation is arrested in the first-named structures, the cartilages do not undergo destruction. There are, however, changes incident to the cartilage itself, which commence and proceed independently of any morbid action either in the synovial membrane or in the bone. In old

age, for example, atrophy of the articular cartilages always takes place: it advances gradually, until the whole cartilage may be entirely removed. Toynbee says, "Articular cartilage during the whole of life gradually becomes thinner, by being converted into bone."<sup>1</sup> Whether it be atrophy of the cartilage simply, however, or whether this be converted into bone, a concomitant change in the articular surface of the bone is observed; namely, calcareous degeneration. This change, however, is a condition incident to age, and is not a state of disease.

There is another, and in its results, a somewhat similar affection, to which I must refer, namely fibrous degeneration. This affection of the articular cartilages occurs for the most part in elderly persons who have been subject to rheumatic pains in the joints. In the first instance, the cartilage loses its glistening appearance; fissures then form in it vertical to the surface, and gradually and slowly they pass through it to the calcareous surface of the bone, widening as they advance, until the cartilage is entirely removed. This change commences in the cartilage; and other structures are not necessarily involved.

This destruction of the cartilages is altogether unsuspected, the process being without pain and mobility not being disturbed. Simultaneously with this destruction of the articular cartilage, a change takes place in the articular surface of the bone itself (similar to that which results from age and to which allusion has been above made)—porcellaneous transformation, or eburnation. This, as Dr. Redfern remarks, is the only repair which is observed when the whole thickness of the cartilage is thrown off without the occurrence of disease in the neighbouring parts. Dr. Little expresses it thus, "Sometimes the erosion or attrition of cartilage and bone is succeeded by the deposition of a new material resembling cartilage, lubricated by the fluid of the articulation, and serving the purpose of original cartilage."<sup>2</sup>

<sup>1</sup> 'Philosophical Transactions' 1841.

<sup>2</sup> 'On Ankylosis,' p. 24, 1843.

Thus, it is shown, that disease being limited to the articular cartilages, the motion of the joint may remain almost unimpaired, and that, when mobility is destroyed, other textures besides the articular cartilages are first affected.



## CHAPTER II.

### FIBROUS, OR FALSE ANCHYLOSIS.

It has been shown that there are numerous causes of false ankylosis; and that such cases may be divided into two classes, namely, extra-capsular and intra-capsular.

*Extra-capsular ankylosis* depends on inflammatory product, whether induced by burns, phlegmonous erysipelas, mechanical injuries, or, indeed, it may be induced by any form of inflammation through which lymph is deposited external to and upon the capsule; while *intra-capsular ankylosis* is occasioned by various forms of inflammation which have affected the structures within the capsule, and through which adhesions have been formed.

Thus, the fibrinous deposit, whether within the joint or external to the capsule, becoming organised, constitutes false ankylosis.

Lymph is poured out upon the capsule and into the cellular tissue around a joint, and about the sheaths of the tendons and muscles in its immediate vicinity; and these parts become more or less matted together and fixed, whether in an extended or a flexed position, and their functions are impaired. And when the interior of the joint is affected, and even when it is destroyed, adhesions are formed between opposed surfaces, and the inflammatory product becomes organised, and mobility is impaired. Both in intra- and in extra-capsular inflammation the amount of injury to the limb depends in some measure on the character of the inflammation. It depends much more, however, on the manner in which that inflammation has been treated; whether with rest and care from the com-



mencement or negligently. For, in proportion as the inflammation is of long standing, so probably will the adhesions be dense, and even extensive. Sometimes the adhesions are slender, simply fibrous bands, or cords; but they may entirely prevent useful motion. And, again, they may be much more extensive, but, having become elongated, they will allow of more motion than the former. When disease has been arrested, and the joint surface is restored to a healthy condition, the articular surfaces still occupying their normal positions, any adhesions which have formed may be so dealt with that mobility may be restored.

In gonorrhœal, or urethral rheumatism inflammation takes place of and about joints, following upon some urethral irritation. In the course of ten days to three weeks one or more joints become stiff, painful, and swollen; and perhaps, at the same time, the soles of the feet are painful, and the conjunctivæ may be inflamed. This probably follows exposure to cold and damp. As the articular inflammation increases the urethral discharge diminishes, and at length it ceases or degenerates into gleet; and serum is extensively effused into and around the synovial cavity, so as to produce great swelling, and tension of the integuments. Suppuration, however, never occurs with this form of inflammation; but lymph is deposited on the synovial membranes, and adhesions form between the opposed surfaces.

When effusion takes place, the limb remains in a semi-flexed position, for the structures around the joint are thus more relaxed than when the limb is extended. When, however, the hip-joint becomes ankylosed after this form of inflammation, the limb is fully, or nearly fully, extended.

The effused fluid may be removed, and the joint may resume its healthy action; but more or less stiffness remains during several weeks, and a crackling sensation is communicated to the hand on moving the limb. Dislocation, however, never takes place in this form of in-

flammation, notwithstanding that effusion may be very considerable. This fact may be said to be diagnostic of the disease; for whereas in every other form of articular inflammation the tendency is towards displacement, in this form, where the effusion is perhaps greater than in any other, displacement never occurs.

The first attack of articular inflammation is always preceded by a specific gonorrhœal discharge, and a subsequent attack will probably be preceded by urethral discharge. The same character of articular inflammation may, however, be re-excited without urethral discharge being developed.

Having once suffered from this form of inflammation, the patient is extremely liable to a recurrence of it. The inflammatory attack, if not more severe on the second than on a previous occasion, leaves more traces behind it; and it is perhaps more virulent in character on account of the debility of the patient. Also, the damage to the affected articulations is greater. Thus, one or more joints may remain ankylosed. Each attack of inflammation leaves behind it more severe and permanent traces of the disease than the previous one. The knee-joint is perhaps affected more frequently than any other joint; but the hip suffers scarcely less frequently than the knee.

It is now some years ago that F. C—, a lieutenant, while serving in Ceylon, contracted gonorrhœa. Late in the afternoon when the urethral inflammation was still acute, he fell asleep while lying on a low broad wall, and was thus exposed to the damp of the evening. On waking he found himself covered with the night dew, and immediately experienced great pain all over the body, but especially in one hip, so that he required assistance to enable him to return to the house. The hip became excessively painful, and the effusion about the joint was so great that it was thought suppuration must ensue. Neither, however, did suppuration take place, nor did the head of the femur become dislocated, but false ankylosis of a very firm character resulted.

But, besides the hip-joint, both shoulders, one knee, and one ankle-joint became inflamed ; and, with the exception of the hip, all these joints passed through the inflammatory condition without material injury ; and at length they recovered perfectly.

Sometimes the urethral discharge seems to alternate with the articular inflammation. Thus, the discharge will cease as the articular inflammation is developed, and it recurs as the articular inflammation subsides. I have known this alternation of inflammation to continue for several weeks, and at length ankylosis to result from it.

The first attack of gonorrhœal rheumatism, if promptly treated, may terminate in complete recovery and without leaving behind any ill effects. Also, a second attack may terminate in a similarly fortunate manner, though this may be somewhat rare. But a third attack generally leaves behind it some serious results. The following is a case in point.

A gentleman wrote to me, asking me to go to him, as he wished to consult me, but could not come to me. When I saw him he told me the following history :

When he was twenty-five years of age he contracted a gonorrhœal discharge, which was followed by synovial inflammation with effusion into both knee-joints. He was confined to the house during a fortnight or three weeks, and was then again able to walk about. At this time, however, the swelling and stiffness of the knees had not quite subsided. The urethral discharge continued for two months, and then it ceased. Before three months had elapsed, the knee-joints were again fit for use. At this period, he again contracted a gonorrhœal discharge, and it was followed, in the course of some few days, by inflammation of the left hip-joint, of both ankle-joints, and of the tarsal joints. The swelling and stiffness lasted longer on this than on the previous occasion ; and, indeed, ten months passed before he was able to walk even with sticks. Stiffness continued after this time



yet for many months, but at length he regained the use of the affected joints.

In 1852, a similar series of events occurred as before. On this occasion, however, both hip-joints became inflamed, as well as both ankle-joints and one knee-joint. The effusion and pain were greater on this than on any previous occasion, and he was longer in recovering. Indeed, he never entirely lost the stiffness about the hips, and always had difficulty in rising from his chair.

In 1854 he married. Articular inflammation returned with redoubled violence, without any urethral discharge being present, and attacked in succession every articulation in the body.

I found him with ankylosis of all the cervical vertebræ, and of most of the dorsal-vertebræ, as well as of both hips. Subsequently, ankylosis of the temporo-maxillary articulations, the shoulder-joints, and the knees took place. And before death occurred, the entire skeleton was ankylosed: he could not even move his head.

The recurrence of this form of inflammation is sometimes very remarkable. I saw, with Dr. William Ogle, in St. George's Hospital, E. G—, aged 46, on account of considerable effusion into, and thickening about, the knee-joint. Ankylosis of the wrist-joint, the vertebræ, and the ribs had taken place. The breathing was diaphragmatic.

In the year 1855 (thirteen years prior to his second admission), he was a patient of Dr. Wilson's, in Cambridge Ward, for gonorrhœal rheumatism. Since that period he had never contracted gonorrhœa, but had at times suffered pain in various joints. Gradually his back and neck, as well as the wrist and the knee, became stiff.

Together with partial displacement of the articular surfaces, there is, also, frequently found a state of partial ankylosis. Some of these cases admit of rectification of

the limb. In the majority of instances, however, this amelioration can only be partially accomplished, and it cannot always be maintained even after tenotomy has been performed. It is unnecessary to say that there can be no hope of restoring mobility, unless the position of the limb, as regards the articular surfaces, is in the first instance rectified.

Anchyllosis of the maxilla takes place either in consequence of cicatrices through injury to the mucous membrane of the cheek, or otherwise through inflammation of the temporo-maxillary articulation.

A cicatrix which results from destruction of the mucous membrane, even though it should not extend entirely from one alveolar border to the other, gradually and slowly contracts as cicatrization becomes complete. At length the teeth are firmly fixed one row upon the other, so that they cannot be separated; and perhaps the only motion of the jaw which remains is a slight lateral motion. This cicatrix may easily be felt by introducing the finger between the lips, and it may readily enough be divided. But this mode of treatment of cicatrices, whether of the mouth or elsewhere, seldom answers its intended purpose. Again, the cicatrix may be dissected out; but another will form, probably harder and more dense than the first. These cicatrices, which result from ulceration and sloughing of the mucous membrane of the mouth, are always preceded by such an amount of painful inflammation that the masseter muscle becomes in a measure affected by it; and long before the cicatrix has formed to impede the separation of the jaws the child refuses to open its mouth, and keeps it more or less closed. This painful condition of the muscles results in structural shortening, so that after the cicatrix has been divided, the jaws can only be separated by further mechanical force.



## CHAPTER III.

### DIAGNOSIS.

M. BONNET wrote, "We have not any certain signs by which we can recognise bony ankylosis." This sentence was written, however, before anæsthetics were in general use in surgery. Now, it is easy to recognise bony ankylosis.

It may be difficult, however, to grasp a bulky limb with one hand above and the other below the articulation, and thus to overcome the influence of its proper muscles, so that no doubt shall exist as to the condition of the articulation. Also, in the case of the temporo-maxillary articulation, the teeth of the upper and lower jaws may be so closely approximated, that, except under the influence of chloroform, it may be impossible to determine that one at least of these articulations is not ossified.

As a general rule, the sensation of solidity in bony ankylosis is unmistakable, on grasping the limb above and below the articulation. Bony consolidation in the movable articulations is so rare, however, that an examination should always be instituted after ether has been exhibited, before it is asserted that bony union has taken place.

False ankylosis is the rule ; and this form is so common that adhesions should always be held to be fibrous until they are proved to be bony.

Immobility alone is not a sign of synostosis : it not unfrequently exists where the adhesions are fibrous. And even when ether has been administered, immobility may be as great as before.

Immobility will frequently exist until muscular action is entirely removed through anæsthetic influence: then, a certain, definite amount of motion may usually be obtained. Occasionally, however, the limb will remain utterly motionless as before; but the sensation communicated to the hand will not be that of bony union. These points are shown in the following cases:

W. C—, aged thirty-eight, a powerful sailor, in July, 1857, fell from the rigging of a man-of-war on to the deck, a height of twenty feet, fracturing the femur in the upper third. Union took place, but with considerable irregularity, so much so that the bone might be seen projecting on the outer side of the limb. I saw him first in May, 1859. He appeared to be suffering from partial ankylosis of the knee-joint. The limb was fully extended, and there was just perceptible motion at the knee. On endeavouring to overcome the resistance, the extensor muscles of the leg were made slightly more tense than before, and motion was stopped suddenly, as though by a process of bone. Chloroform was administered, and then it became obvious that, whatever other impediment might exist, the contracted condition of the quadriceps extensor was the cause of immobility. It was, therefore, determined to divide the tendon of this muscle. Division was effected at two inches above the patella, so as to avoid the synovial bursa. The joint was immediately free, and it was seen that no adhesions existed about the joint. Gradual flexion was afterwards employed, and at the expiration of two months the knee could be bent at a right angle. The patient subsequently walked well and easily, and could even again go aloft.<sup>1</sup>

In this instance, the shortened condition of the muscle was the sole cause of immobility.

Some years later, I was called upon to examine an ankylosed hip on the day following that on which another surgeon had examined under chloroform. Considerable force had been exerted to break through the

<sup>1</sup> The 'Lancet,' August 27th, 1859.

adhesions, but no movement at the hip could be obtained ; and it was, therefore, inferred that bony union had taken place ; and the case was in consequence abandoned. On examination, and before chloroform was inhaled, I found that the usual sensation of bony consolidation was absent. Chloroform was, therefore, administered to its fullest extent by Mr. Clover ; and, in the presence of those who had previously attempted it, I ruptured the adhesions with the application of very slight force—using one hand only. The joint was immediately free in all its motions. No pain whatever was excited by this operation ; and, indeed, the patient could not be convinced that it had been performed, until the splint was loosened and the joint was gently moved. Then, he was content to remain quiet in bed.

Whenever the muscles of the limb can be thrown into action, so as to render the tendons prominent, or tense about a joint, the adhesions are not bony ; nor are they bony when the slightest motion is found to exist.

Gentleness in manipulation is necessary in order to distinguish exactly the condition of a joint. Rough handling is inadmissible. It is especially inadmissible, because it tends to mask the condition into which we desire to gain an insight. M. Sanson relates a case which shows this point well. He says, “ I have seen an hospital surgeon raise by the thigh a child who was suffering from hip-joint disease, and because the pelvis did not move on the thigh, he concluded that ankylosis had taken place. A bystander, however, by no means convinced, withdrew the child’s attention, and the limb was then easily abducted or adducted. Thus, whilst the muscles spring into action to resist violence, the limb is readily moved with gentleness and when pain is not excited.”<sup>1</sup>

This error, to which allusion is now made, is not uncommon. A child, five years of age, was sent over to me

<sup>1</sup> ‘ Dictionnaire de Médecine et de Chirurgie Pratiques,’ 1829. Art. “ Ankylose.”

from Normandy, with a request that I would rupture the adhesions, it being supposed that anchylosis of the hip-joint had taken place. On examination, I found hip-joint disease, with thickening of the synovial membrane; but adhesions had not formed, and motion was permitted in every direction, *when the limb was handled gently*.

Thus, when a limb is handled gently, so that the muscles are not thrown into action, it may almost always be determined whether anchylosis be true or false—solid bony union communicating the sensation as of a single bone, whereas fibrous anchylosis generally allows of a certain amount of yielding, if not of motion. After anæsthesia has been obtained, doubt can scarcely any longer exist as to the nature of the adhesions.

But, although fibrous adhesions may be diagnosed, it is often extremely difficult to distinguish between intra- and extra-capsular adhesions. Frequently, it is impossible to make this distinction, except at the moment when the adhesions are being ruptured. Then, the seat of the adhesions may usually be stated with precision; and not only may the position of the adhesions be diagnosed, but also their extent. The consideration of the primary forms of inflammation will usually assist in this part of the diagnosis, as I have endeavoured to show in the previous chapter. And that the treatment may be adequate to the case, it is essential that the primary form of inflammation should be considered in every case of false anchylosis; for, while some forms yield to gradual extension, others resist except when force is applied suddenly.



## CHAPTER IV.

### TREATMENT OF FIBROUS, OR FALSE ANCHYLOSIS.

“THE treatment of ankylosis has always been,” as Professor Bauer truly remarks, “a cherished object of surgery from Hippocrates down to the present time. Success is, however, but of recent date.”<sup>1</sup>

The treatment of partial ankylosis may be divided into—1st, gradual extension of the limb, with or without tenotomy; and 2nd, immediate flexion of the limb, with or without tenotomy, and subsequent gradual extension.

In all cases of partial ankylosis there exists some muscular rigidity. Also, in some cases, cicatrices are found, resulting from loss of substance. Where adhesions are recent, contraction of a limb may probably be overcome by continued extension—such extension, namely, as is made by means of a well-adjusted instrument for the purpose. But, except in cases of recent adhesions, it is generally necessary to commence the treatment by dividing the tendons of rigid muscles and cicatrices subcutaneously. It is better to proceed at once to the subcutaneous sections rather than to prolong the treatment by extension unnecessarily; for unless the adhesions are recent, simple extension is seldom of itself and uncombined with subcutaneous sections sufficient to remove the contracted condition of a limb. It is important to remember this principle of treatment, for partial displacement of the articular surfaces is easily induced by continued extension of the limb, unless the tendons have been previously divided. Indeed, it is not uncommon to see this displacement take place at the knee when extension is long

<sup>1</sup> ‘Lectures on Orthopædic Surgery.’



continued, and where the tendons have not been divided. Whenever, therefore, it is desired to remove contraction, it is well first to divide the tendons of rigid muscles and any cicatrices subcutaneously, and subsequently to proceed gradually to extend the limb.

But if such be the law of treatment where the articular surfaces occupy their normal positions, it is even more to be insisted on when any displacement has taken place. Extension should then without fail be preceded by the subcutaneous section of such tendons, fasciæ, and cicatrices as would interfere with the readjustment of the articular surfaces.

These obstacles to extension, then, having been removed, a well-adapted instrument is to be applied to the limb, and extension is to be made slowly. The instrument should support the limb efficiently, and it should always, in the first instance, be applied at that angle, whatever it may be, at which the limb was held before the subcutaneous sections were made. So soon, then, as the punctures have healed, extension should begin ; and it should be carried on gradually without exciting pain, and without producing any displacement.

Numberless cases exist, however, in which the means above mentioned are useless to restore to the limb either the normal position of the articular surfaces or to restore mobility ; cases, for instance, in which the adhesions are so firm that they do not yield to gradual extension. The pressure produced by continued extension may occasion destruction of the integument, or it may induce displacements, partial or complete, of the articular surfaces ; but the adhesions, whether intra- or extra-capsular, will not yield to such force. Injury alone, but no useful result, can accrue from gradual extension in these cases. Before chloroform was introduced these were among the *opprobria* of surgery. Then gradual extension of such limbs was continued for months, and it is sad to say, for years even, without any advantage being derived.

Mr. Wickham, in his excellent treatise, says, " It

is a common expression of surgeons, 'I stiffened the joint,' implying both that there are circumstances which warrant its being done, as well as that there are means of producing the effect. By this hackneyed expression, and my own observation, I am inclined to think, however," says Mr. Wickham, "that many joints are unnecessarily sacrificed to this act. Anchylosis is to be regarded as a complete annihilation of the functions of the diseased joint; therefore, in all cases a serious evil, and, if possible (consistently, that is, with security from greater evil), to be prevented. It seems to me that attempts to accomplish this process are unjustifiable, so long as there exists a probability of a return of the functions of the part. *It is only, then, when we know that the natural textures of a joint are destroyed that anchylosis may be hailed as a salutary termination of the disease. On the contrary, until such destruction can have been ascertained, every effort should be made use of to avert or remove it.*<sup>1</sup>

Thus, it is necessary, before proceeding to the treatment of a case of this kind, to form a correct diagnosis—to determine, in fact, whether complete anchylosis has taken place, or whether the adhesions are fibrous; and, if fibrous, whether they will or will not yield to gradual extension. If these several points cannot be otherwise determined ether should be administered, so that, when complete muscular relaxation has been obtained, both the character of the adhesions and the amount of motion of which the limb is capable may be fully recognised.

But although we may, at the first opportunity, and without unnecessary delay, remove an anchylosed condition of a joint, we must yet wait until morbid action has subsided. In the words of Professor Pirrie, "Anchylosis should on no account be interfered with until all diseased action has ceased, and the parts have returned to a quiescent state."<sup>2</sup> Then, treatment will be advantageously employed;

<sup>1</sup> 'A Practical Treatise on Diseases of the Joints,' p. 118.

<sup>2</sup> 'The Principles and Practice of Surgery,' 2nd edition, p. 446.

whereas benefit can scarcely be expected whilst the limb is in an inflamed or a painful condition.

When bony union has taken place, a sense of solidity and continuity of structure is communicated to the hands on grasping the limb above and below the articulation; but when fibrous adhesions have formed, either slight motion may be felt at the articulation, or at least a sense of elasticity is communicated on endeavouring to flex the limb. And if the adhesions are so firm and unyielding that motion as well as the normal position of the limb can only be gained by force suddenly applied to rupture the adhesions, the force should be so applied that it is used mainly, if not entirely, in flexion of the limb.

Examples of rupture of ankylosis are mentioned by Meckren and Bartholin. And Amussat communicated an instance to the Académie de Médecine, in 1831, of forcible extension of the limb where the patella also was adherent to the inner condyle. But the operation may, indeed, be said to have been instituted by Louvrier, whose attention had been especially directed to cases of this description. He was successful in the first five cases which came under his care. Afterwards he sought a larger field for his ambition, namely, in Paris; and, not being able to distinguish between true and false ankylosis, he accepted for operation every case of ankylosis which presented itself in the hospitals. Then, he was as unsuccessful as he had been previously successful.

The 'Gazette des Hôpitaux' announced him thus:—"A young physician, M. Louvrier, has lately arrived in Paris from the department of Doubs. He has invented an apparatus, and has instituted a new method for the cure of ankylosis; and he has, in consequence, visited the metropolis, hoping to meet with as much success as at Besançon and elsewhere. If the results of his operations are as certain as he asserts, our most hearty acknowledgments will be due to him. The treatment of ankylosis, in whatever condition it may be (*à tel état qu'elle soit*),

is simple and easy to him: in some few moments the affection is radically cured; and, in the course of a very few days, he is able to restore to the limb its full power and mobility."

Such a statement could only impose on one ignorant of pathology. M. Louvrier, however, was allowed to try his success in the hospitals of Paris; but, not having the requisite knowledge, he accepted all cases that were presented to him for treatment; and not knowing what to refuse his zeal soon led him into inextricable difficulties. M. Bérard presently after being ordered to make a report on the subject of these operations to the Académie de Médecine, public attention was specially directed to Louvrier and his operations. The report was unfavorable.

Louvrier applied sudden, forcible extension, by instrumental means, to all cases of ankylosis—whether firm bony consolidation had taken place, whether the patella was adherent to the femur, or when false ankylosis alone existed. He did not form an accurate diagnosis, distinguishing between true and false ankylosis, and the results of his operations could, therefore, scarcely have been otherwise than it proved.

As Velpeau said, when bony consolidation has taken place, such an operation is "cruel and barbarous." But he went on to say, with that sarcasm which was peculiarly his own, "M. Louvrier ne comprend pas comme nous l'histoire des ankyloses."

One of the cases which brought this practice especially under the notice of Louvrier was the following, which was recorded by M. Cazenave,<sup>1</sup> of Bordeaux.

*"Penetrating wound of the right tibio-femoral articulation, followed by complete ankylosis, which was cured accidentally."*

"M. Expert, of Cerons, fifty years of age, whilst at work in his vineyard, wounded his knee with a hatchet. He felt some slight pain at the time, and immediately

<sup>1</sup> 'Journal des Connaissances Médico-Chirurgicales,' 1837.



returned home, walking a distance of a mile and a half. Having arrived at home, he raised his trousers to examine the wound, when he found that it was about an inch in length. It bled but little; but he observed that, from between the lips of the wound, a transparent, viscous fluid flowed in considerable quantity; especially it flowed when he moved the limb in flexion or in extension, as he did to assure himself of the perfect integrity of the joint-motions.

“The surgeon of the locality was sent for. He recommended exercise, and, if it were necessary, force, that the joint might not become stiff; and also, that hot wine, with brandy, should be constantly applied.

“In a short time, fever was excited and dreadful pain was felt in the limb. Notwithstanding, the surgeon desired his patient to walk during the whole day. This was rigorously performed; that is to say M. Expert walked limping and supporting himself with a stick, until the swelling and pain of the joint obliged him to go to bed. On the following day,” says M. Cazenave, “I was sent for. I found a small quantity of synovia escaping from the wound, the knee enormously swollen,” &c. &c. “At length it became evident that ankylosis could not be prevented: all means that could be imagined were resorted to, but without any advantage being gained. In the following year he went to Baréges, and he returned in the same condition in which he went.

“Six weeks after his return from the Pyrenees, and towards the end of the vintage, being impatient and unwilling to wait for his driver, he himself tackled the oxen to the waggon, mounted, and, standing, urged on the oxen. Presently, one of the wheels came into contact with a post, when he was violently thrown forward and fell on his ankylosed knee. M. Expert was uninjured by the fall, but he rose perfectly cured of his ankylosis.”

M. Cazenave adds, “M. Expert is still living at Cerons, and the facts which I have related are known to my professional brethren in the neighbourhood,” of whom he mentions the names of eight.

This, then, is one of the cases, and it is so original that I am unable to refrain from transcribing it here, from which Louvrier borrowed his idea of removing ankylosis, "*whatever its condition might be.*"

As practised before chloroform was in use, this was a terrible operation. Dieffenbach<sup>1</sup> was among the first to modify the operation. He divided contracted tendons subcutaneously, and immediately afterwards ruptured the adhesions by forcible extension of the limb. In many instances, in consequence of the force which was employed, the punctures were extended even into lacerations.

Palasciano, Surgeon to the Hospital for Incurables at Naples, extended the practice which had been introduced by Louvrier, and with some success. He ruptured the adhesions after having divided the tendons of contracted muscles. This treatment had fallen somewhat into abeyance when he again directed attention to the subject, and he was followed by several leading surgeons, such as Bonnet, who was the exponent of this practice in France, and especially by Berend and Bühring in Germany. Especially Bonnet<sup>2</sup> was struck with the observations of Palasciano, and constructed with him a splint for the better treatment of these cases. He operated first in 1847, and his first case was, he says, successful. That is to say, he straightened the limb; and so it became stiff. His second operation was done in 1850, and with a similar result.

Dr. Delore<sup>3</sup> published a highly appreciative memoir of Bonnet and his treatment of ankylosis, so that it may fairly be said that the learning of the pupil even surpassed that of the master.

Rizzoli,<sup>4</sup> of Bologna, added to our knowledge by his treatment of ankylosis. But of all who have gone before, none have shown so distinctly as Palasciano<sup>5</sup> what should

<sup>1</sup> 'Ueber die Durchsehneldung der Sehnen und Muskeln,' 1841.

<sup>2</sup> 'Traité de Thérapeutique des Maladies Articulaires,' 1853.

<sup>3</sup> 'Du Traitement des Ankyloses,' Paris, 1864.

<sup>4</sup> 'Operazioni chirurgiche eseguite in diversi casi onde toglieri la immobilità della mascella inferiore,' 1858.

<sup>5</sup> 'Mémoires sur la rupture de l'ankylose du Genou,' Lyon, 1847.

be the treatment in cases of this description. He applied it alone to the knee; but he used flexion and tenotomy.

Langenbeck<sup>1</sup> also saw in this operation a means of restoring power to a crippled limb; and, availing himself of the inhalation of ether, he thought it unnecessary to divide the tendons of contracted muscles, and therefore divided fasciæ only; and afterwards ruptured adhesions. But, notwithstanding the advantage which anæsthetic agents gave him, his operations were not so successful as were those of Dieffenbach: displacements more or less complete were frequently produced.

Three years later Philip Frank,<sup>2</sup> in his 'Inaugural Dissertation,' gave further results of Langenbeck's operations. Langenbeck's operations were rendered easier by the use of chloroform; but he committed a grave error in not dividing the tendons of contracted muscles.

Contraction after inflammation of joints is due to muscular action, that the limb may be placed in a semi-flexed position; for, as has been already shown, in this position the ligaments are relaxed, and more space is in consequence allowed for the effused fluid. The flexors are always more powerful than the extensors; and so long as inflammation exists these are powerless to overcome the flexors; and thus, lymph being deposited on the thickened synovial membrane, when the effused fluid is removed the adjacent surfaces come into contact and adhesions are formed. Under these circumstances occasionally intense pain is caused by the flexor muscles drawing the leg-bones into forcible contact with the thigh-bone, and to relieve this it becomes necessary to divide the flexor tendons. This mode of treatment is illustrated in Case 25; and also by a case recorded in the 'St. George's Hospital Reports,' vol. v, p. 151. In both of these cases the pain caused by pressing the leg and thigh-

<sup>1</sup> 'Commentatio de Contractura et Ancylosi Genu, novo methodo violentæ extensionis ope sanandis,' Berol, 1850.

<sup>2</sup> 'De Contractura et Ancylosi Articulationis Genu et Coxæ iisdemque B. Langenbeckii methodo violenta extensione sanandis.' Berol. 1853.



bones together through the contracted muscles, was instantly relieved by dividing the flexor tendons. Under such circumstances, it is right to alter the position of the limb, even though inflammation still exist. The adhesions then being soft are easily extended, and, if they are firmer, a movement of flexion will snap them; and gradual extension may immediately afterwards be made, so as to separate the articular surfaces.

But, in extending the leg, for instance, as was done by Langenbeck, without first dividing the flexor tendons, there is great risk incurred of producing subluxation. And, indeed, unless the flexors yield in proportion to the extension which is made subluxation must occur; the bones of the leg being drawn backwards into the popliteal space, or under different circumstances they may be drawn inwards, as in genu valgum. Thus, Bonnet, profiting by what may be deemed an error in the practice of Langenbeck, extended the limb after having divided the tendons of contracted muscles.

Even, however, after dividing tendons immediate extension is always attended with danger, and therefore ought to be avoided. Damage is done, more or less, to all the soft structures concerned: muscles are torn, and the skin also may suffer; and I have known both vessels and nerves to be ruptured. Also, bones may be fractured. But, in flexion none of these injuries can occur. I have performed upwards of one thousand operations of this nature, and with the employment of anæsthetics, and tenotomy when necessary, I have practised immediate flexion, and have never known any *contretemps* whatever—neither fracture nor rupture nor dislocation nor pyæmia nor inflammation.

Professor Bauer says, "About 600 cases of this affection—contraction and ankylosis—of the knee-joint have given me ample opportunity for most thorough clinical observation, and entitle me to participate in the important question which is still being discussed before the highest scientific tribunals of Europe. On the feasibility of



forcible rupture of adhesions all are agreed. Its superiority over gradual extension can no more be questioned; and its former opponents have been effectually silenced by the overwhelming results which have been produced.”<sup>1</sup>

In the treatment of false ankylosis by rupture of the adhesions, there are some conditions which seem to be indispensable, and to which I will now draw attention.

1st. It is essential that anæsthesia shall be so complete that the action of the voluntary muscles be entirely suspended.

2nd. That tense cicatrices, fasciæ, and tendons be subcutaneously divided, and that the punctures be allowed to heal before the limb is flexed. When this precaution is neglected, the punctures may be extended into gaping wounds; especially this is liable to occur in the neighbourhood of large joints: the cellular tissue will be lacerated, and infiltration and abscess will follow. No train of circumstances can be more unfortunate than this, nor can any be more certain to preclude the benefit which was intended by the operation.

3rd. That moderate force alone be used to rupture the adhesions.

When complete relaxation of the voluntary muscles has been obtained, only slight force is required to rupture membranous or fibrous adhesions; for there is only then slight resistance to overcome, namely, that presented by the adhesions themselves. The weight of the limb should not be allowed to interfere with the force to be employed; and thus, it is convenient to sling the limb. (See Fig. 1.)

4th. That adhesions should be ruptured in flexing the limb.

It very rarely occurs that the adhesions are so placed that they cannot be ruptured in flexing the limb. In forcible flexion of the limb, injury cannot possibly accrue to vessels or muscles or other structures; neither can dislocation occur when this is observed. Further, this operation is for the most part painless.

<sup>1</sup> Op. cit., p. 113.

When anæsthesia is complete there can be no injury except to the adhesions themselves, and consequently the subsequent pain is either slight, or it is entirely absent.

5th. That the adhesions should simply be ruptured, and that no attempt should be made at that time to restore the position of the limb; nor, indeed, should the condition of the joint be further investigated. This is a point to which attention should be especially directed. In some instances it may doubtless be disregarded, but for the most part attention to this rule conduces largely to success.

Besides it is unnecessary to examine the state of the joint at this time. The operator may rest assured that the joint is free when he has heard the snap, or when he has felt the limb suddenly yield. His whole aim, then, should be to prevent pain, and this is most certainly effected by preventing any further motion of the limb.

Before ether is administered a splint should be moulded to the limb; and it may be allowed to harden while anæsthesia is being produced. This splint is to be applied to the limb as soon as the adhesions have been ruptured, and it may be worn so long as tenderness about the joint exists. When tenderness has disappeared passive motion may be employed, and it may be repeated daily. In some cases it is necessary to produce anæsthesia on several occasions when the joint is being moved. The pain which is induced by motion is generally referable rather to rigidity of the muscles than to the condition of the joint itself. The hot-air bath frequently acts as a charm in removing this muscular pain.

Impediments to motion having thus been removed, such as tense tendons and fasciæ and contracted cicatrices, and the punctures having healed, the full effect of ether, namely, the entire relaxation of the voluntary muscles, is to be obtained, and the limb is to be brought into such a position as to render the adhesions

tense. Then, a slight jerk in the direction of flexion will rupture any fibrous adhesions. A large number of cases are held to be incurable for want of such simple management.

If adhesions are to be ruptured with security and without injury to the bone of the limb, the foregoing precautions must be attended to.

I have known several cases where efforts have been made to break through adhesions without success, to be abandoned as hopeless and regarded as instances of bony ankylosis, and yet they have yielded to a slight effort when the action of the muscles was entirely removed, and the limb was so supported that its weight could offer no impediment to the operation.

When the weight of the limb is removed and the action of the muscles is suspended, a slight jerk is generally sufficient to separate any adhesions that may exist. I seldom apply greater force, even where the hip-joint is concerned, than can easily be exerted with one hand; nor have I found it necessary to apply more than a moderate degree of force: more is not required.

Rupture of the adhesions is generally attended with an audible result, and with more or less sudden yielding. When the adhesions are rigid, they give way with a loud snap, somewhat analogous to the fracture of bone; and when they are extensive, but less rigid, their rupture is attended with a prolonged tearing sound. In other cases where they are slight, they yield almost without sound.

If one point is more worthy of attention than another, it is, perhaps, the management of the skin while the adhesions are being acted on; for, where adherent cicatrices exist, laceration of the integument easily occurs. Adherent cicatrices and points of adhesion, therefore, should be previously subcutaneously divided, so that unequal pressure may be removed during the act of extension. Should the continuity of the integument be endangered by the force which may be necessary to replace the articular surfaces, it is preferable to

complete this replacement on a future occasion rather than to risk the smallest rent of the skin. As might *à priori* be expected, those cases are attended with the greatest success where the adhesions are ruptured on the application of slight force, and which yield with a single snap ; where the skin is in no measure endangered ; where the adhesions are extra-capsular ; and where the integrity of the joint is so far preserved that there is no tendency to dislocation.

When partial dislocation exists, or when extensive adhesions have been formed, it may be necessary, in the first place, to restore the shape of the limb, or by gradual extension to place the limb in such a position that it may be available for motion. Long-continued manipulations under the influence of chloroform, together with friction and passive motion, and the use of the hot-air bath, will then together tend to replace the extremities of the bones and to restore mobility to a limb which has long been considered to be hopelessly stiff.

The hip when anchylosed causes more inconvenience than any other joint, except, perhaps, the maxilla. When anchylosis has taken place in the extended position of the lower limb, for instance, the patient can only sit on one side, with the affected leg thrown backwards. Continued pressure on the buttock soon becomes painful, and the leg of the affected side becomes cramped. Thus, the sitting posture is not only awkward, but, after a very short time, it is also exceedingly painful. But the most painful position is on horseback. Not only is the seat most insecure, but much pain is occasioned. And this is even felt more on dismounting than in the saddle. I have operated on several cases of mounted officers ; and although entire motion was not in every instance restored, yet the relief was usually great. One of these gentlemen whose hip-joint was entirely motionless, and who suffered much pain in riding, and especially on leaving the saddle, wrote to me eight months after the operation, and said, " I am in the saddle all day, and have no pain." In this instance the joint-



motion was restored, and became as perfect as that of the other limb. The relief which seems to be most appreciated is that arising from the ability to flex the thigh, and consequently to sit fairly and straight on a chair. This position, before the separation of the adhesions, is impossible; and it causes very considerable satisfaction to find that the power has been regained, and that the sitting posture can again be assumed without pain.

When the patella is adherent, it is usually ankylosed to the outer condyle of the femur. The prognosis is necessarily less favorable when these adhesions exist.

Any tendons, then, which are rigid having been divided and the punctures having healed, and anæsthesia being fully induced, the limb to be operated on should be so firmly fixed that all motion is prevented, except that which the operator is about to impart to the limb. Thus, for instance, if the hip-joint is to be operated on, the pelvis must be fixed; if the knee, the thigh must be securely held; and so on. When the limbs are thus firmly secured, the adhesions are to be instantaneously ruptured by force applied in the direction of flexion. I repeat that the adhesions may be instantaneously ruptured when the patient is properly prepared, and the force is rightly adjusted. The limb is then to be bandaged, and especially the affected joint is to be firmly bandaged, and confined either in a moulded splint or on a flexible metallic splint.

I know of no danger whatever from the use of force so applied. Indeed, when the influence of the muscles is perfectly removed, the adhesions themselves usually offer very little resistance; and if the power to be applied is sufficient for the purpose, the result should be almost, if not quite, instantaneous. In a small number of instances, the hand alone is insufficient to rupture the adhesions readily; and in these I make use of an instrument to flex the limb. Not only is there no danger connected with this operation, but with moderate care it would seem to be impossible to set up unhealthy action. It is sometimes said that in these operations

fracture is not uncommon, and that inflammation is not unfrequently excited. Let it be sufficient for me to say that I have never seen a fracture produced, nor have I known inflammation to occur, nor any other ill whatever to follow an operation of this nature. When disaster ensues it is from abuse of the operation. I know that some unfortunate results have occurred; but in these cases anæsthesia was insufficiently induced, and the motor force was improperly applied. I cannot tell what might be the result of adopting such instructions as the following, which I copy from one of the latest works on the subject. After describing the preliminaries of the operation, the author proceeds thus:—"A cracking noise is heard, which becomes more and more evident as the movements are continued, and at the end, it may be, of *half an hour*, the adhesions may have so far given way as to allow of motion in all directions, to a very considerable extent, in a joint which had appeared completely ankylosed." This, however, is not the manner in which this operation ought to be performed. When carefully performed this operation may be said to be the most successful in the whole range of surgery; and it may be added that there is no operation more free from danger.

Dr. Little<sup>1</sup> observes, "By chloroformisation, the two great obstacles to the employment of force adequate to straighten or bend a contracted limb, namely, pain and voluntary muscular resistance, are removed. As soon as these impediments disappear, the hands of the single operator, and his single mind, applied to the parts, encounter the physical resistance only of the deformed parts; comparatively gentle manipulations now acquaint him with the nature and amount of difficulty; he can feel his way in the application of greater force; can feel and perceive the resistance of parts successfully overcome, in an anatomical order; if greater rigidity still oppose, a few movements of the joint backwards and forwards

<sup>1</sup> "Orthopædic Surgery" in Holmes' 'System of Surgery,' vol. iii, 1870.

prepare the way for a more extensive yielding; and often the practitioner has the satisfaction of being able thus to effect every natural movement of the joint."

When the joint retains its normal external form, the adhesions are easily broken down by the hand, after the limb has been properly placed in position and the full effect of chloroform has been obtained. There was lately under my care in the hospital a patient who, having suffered from rheumatic inflammation, was admitted with partial ankylosis of the knee and of the ankle. The tendo Achillis was, in the first instance, divided, and after the puncture had healed the adhesions were ruptured by flexing the foot upon the leg. On a subsequent occasion the hamstrings were divided subcutaneously, and, the punctures having healed, the adhesions at the knee-joint were ruptured by flexing the leg upon the thigh. This patient walked well when she left the hospital, and without lameness; and the movements at the knee- and ankle-joints were as free as were those of the other limb.

It is a point to remember that, after the tendons have been divided and before the punctures have healed, the adhesions should not be ruptured; or they should be ruptured only with great care, lest the puncture should be extended into a rent. This extension of the puncture is much easier to effect than might be supposed, and it is, therefore, safer to allow the punctures to heal before any motor force is employed.

When the position of the limb is perfectly restored passive motion should commence. At first it may be necessary to administer chloroform, for motion is painful; but, as motion increases, passive movements excite less pain.

I will repeat that, when muscles are so contracted as to interfere with the rupture of adhesions, their tendons should be divided before force is applied. When, however, they are not rigidly contracted, adhesions may frequently be ruptured without section of tendons, and muscular contraction may subsequently be overcome by extension and passive motion.



When adhesions can be extended slowly and gradually, the limb may be placed in the desired position without the application of suddenly applied force. It may happen, however, that when a flexed limb has been fully extended passive motion may be impossible, except under the influence of anæsthetics. No time should be lost in gaining whatever motion is possible after the extending process is complete; for diseased action may recommence if the limb be allowed to remain permanently in one position, and ankylosis may then become complete. Often I have known contraction to have been fully overcome, and the articulating surfaces to have been brought well into position, so that nothing remained to be done but to restore mobility, when the patient has been recommended to move the limb, but nothing has been done to accomplish this end. The treatment is not complete until such motion as is possible is gained; and the patient should not be lost sight of until whatever can be done for him in this direction has been accomplished.

I remember well, some years ago, seeing a case in point. Gradual extension had been employed after section of the hamstring tendons. The adhesions had yielded, and the articulating surfaces of the tibia and the femur had been replaced perfectly, when the patient expressed herself quite satisfied with the result, and obstinately refused to adopt such measures as would have ensured the free motion of the joint. Motion, to some extent, could be borne, even without chloroform; and under a promise that passive motion should be employed, she left for the country. Nothing was done to increase mobility, however; the limb was not even used; so that at the expiration of five months bony consolidation was found to be complete. During these five months there had not been any sensation of pain in the joint.

Passive motion, with or without anæsthesia, or in the hot-air bath, when considerable muscular relaxation has been obtained, will in a large number of cases be necessary to restore mobility.



Those who have hastily discontinued passive motion have lost the advantages which an operation had given them. And, perhaps, more have been turned adrift with ankylosed limbs, because a little trouble was not taken to ascertain that passive motion was properly and efficiently applied.

Ankylosis has even been thought to be a desirable termination of articular disease, and to stiffen a joint to be rather laudable than otherwise. Indeed, some seem to think that all that is necessary has been done when the joint has been made firm and immovable. To restore mobility seems to them hopeless, and the idea even to savour of presumption.

It is sometimes said that it is better to trust to the hand only in producing immediate flexion of a limb rather than to have recourse to instrumental aid of any description. And this is also entirely my opinion. I should even consider it blameable to use instruments until the hand had failed, or to use them except when they are absolutely necessary for success; and then they should be used only with great care and moderation. There are a certain number of cases, however, where the patient would remain crippled for the remainder of life unless something more were done than can be accomplished by the unaided hand. These cases, I confess, I am not prepared to abandon.

The accompanying figure (Fig. 1) gives some idea of an apparatus which I have found useful in slinging the limb in many cases of ankylosis of the hip-joint. It shows how the pelvis is to be fixed, and how the forces are to be directed, so that immediate flexion of the limb may be obtained, after the cord has been tightened. Whilst an assistant supports the ankle, movement in the direction of flexion is imparted with the hand to the extremity of the femur. I am indebted for this apparatus to Mr. Bigg. It is most effective for its purpose when properly applied.

The treatment of ankylosis of the maxilla consists, first, of subcutaneous section of the masseter muscle, and



matter which is deposited being converted into fibrous adhesions, or bony consolidation may take place.

The treatment of these affections of the jaw is greatly complicated by the circumstance that the articulation is surrounded and acted on by very powerful muscles, and also because these muscles—namely, the masseters, the pterygoids, and the temporal muscles—are, perhaps, the last of the voluntary muscles to yield to the influence of chloroform, so that when they become relaxed the patient will already have inhaled a very powerful dose of chloroform. It will readily be understood how this difficulty is increased when inflammation has produced thickening of tissues with adhesions. When the adhesions are recent, they yield to the long-continued use of the wedge, and the mouth may be opened to its fullest extent. It requires, however, a very long and persevering application of the same means to prevent contraction again taking place. When these measures fail, nothing is left but to divide the masseter subcutaneously, and again to extend gradually with the wedges as before.

The following case will illustrate the use of an ingenious instrument invented by Mr. Gumpel for flexing the knee where manual force was insufficient. Fig. 2 represents accurately the case for which the instrument was made, and Fig. 3 shows the instrument that was employed to overcome the adhesions.

CASE 1.—*Anchylolysis of the knee-joint, with partial displacement backwards and with numerous cicatrices.*

A. H—, twenty-three years of age, had suffered from abscesses about the knee for several years. Both the leg and the thigh were much scarred through abscesses which had formed and broken. Portions of the femur had been exfoliated, and part of the tibia was exposed when I first saw him. There was no appreciable motion at the knee-joint, and the tibia was partially displaced backwards. The limb was useless for walking: no weight could be borne

upon it, so that crutches were always used. I was requested to restore the motion of the joint. I declined to attempt immediate flexion of the limb however, and advised that resection should be thought of; but this advice was not acceptable. Three days later he again presented himself, and importuned me to attempt to straighten his limb; and at length it was arranged that an examination under chloroform should be made. Eventually the hamstrings were divided; and subsequently

FIG. 2.

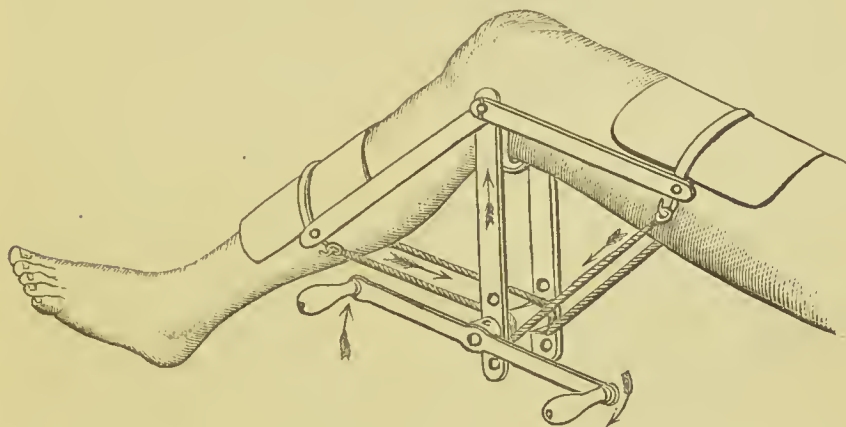


an instrument, consisting of metallic splints, connected with a roller in the popliteal space by means of catgut cords, and acting on the principle of the wheel and axle,



so that when put in motion the splints are approximated, having been adjusted to the thigh and leg and moved, the knee was bent. This instrument is represented in the following figure. So soon as the cords were tightened and pressure was applied the adhesions gave way instantaneously with a loud snap. The instrument was immediately disengaged and the limb was bandaged and supported with splints. Especially the knee was firmly bandaged. I was assisted in this operation by Dr. Jones and Mr. Pick in

FIG. 3.



September, 1866. Opium was administered, and its effect was continued more or less for three days. At the end of a week gradual extension was commenced, for there was no inflammation after this operation; and thus the leg-bones were replaced, and the length of the limb was restored. Before he left London he walked about his room freely and without a stick, and with a stick he walked easily round Grosvenor Square, having gained a considerable amount of useful motion at the knee-joint.

CASE 2.—*Anchylosis of both knee-joints, together with shortening of the femora to the extent of two inches from extensive oblique and comminuted fractures.*

A. W.—, aged nineteen, was riding on the 5th of April, 1876, with a friend in the Bois de Boulogne, when having reached the rides through the wood they urged their

horses to a hard gallop. His friend raised his whip to urge his horse to greater speed, when the horse swerved and cannoned against his companion, driving him against the bole of a tree. The rider's right thigh received the full force of the shock. The femur was broken obliquely about three inches above the knee, and the fracture extended into the joint. He was swept over the tail of his horse, and the left femur was fractured in the lower third. This was a comminuted fracture, and there was much bruising of the soft structures : it was probably occasioned by the horse's hoof while he was lying on the ground. The accident occurred at 10.30 a.m., and he arrived at home between 2 and 3 o'clock in the afternoon. He was seen on his arrival by Dr. Smith of New York, and somewhat later by Dr. Pratt and by Dr. Malspine, and later, in consultation by M. Le Fort.

Both limbs were greatly contused, the right through the violent contact with the trunk of the tree, and the left probably through the pressure of his horse's hoof. In consequence of the great swelling that ensued, it was thought right to place the limbs on pillows rather than to have recourse to more retentive apparatus ; and thus they remained until the swelling had in some measure subsided. Then, long straight splints were applied. When the splints were removed the knees were found to be fixed and immovable.

At the expiration of four months he was able to return to England. On his arrival it was decided, in consultation, that the right femur was not fully united, and it was proposed to cut down upon the broken ends of the bone and to remove them with a saw. This advice was so entirely unexpected that other opinions were sought ; and it was then recommended that the proposed operation should at least be deferred, and that irons should be worn extending the entire length of the limbs and reaching as high as the pelvis. These iron supports were found to be so irksome that they were not worn. Sir William Fergusson's opinion was then asked, and he stated that

bony union of both thigh-bones was complete, and that ankylosis was so perfect in both knee-joints that mobility could never be restored, and he expressed a very strong opinion against any attempt being made to restore mobility.

I was consulted on the 8th of January, 1877, and then saw this gentleman for the first time. He was emaciated and pale, and moved slowly and with difficulty on crutches. The following questions were then put to me by his father, who accompanied him:—Can anything be done to make him walk? Are the thigh-bones united? Is it possible to restore the power of bending the knees? Having answered affirmatively, I heard the history which I have now related.

Ankylosis was not complete in the right limb: very slight movement only was possible, and when this occurred a grating sound was produced by some tendinous fibres which passed over the obliquely fractured and projecting thigh-bone. This resembled somewhat the sensation of crepitus. It was this rough sound which occasioned the belief that union was incomplete. In the left limb there was no movement at the knee-joint; but the adhesions which prevented motion were distinctly not bony. The patellæ were free. Two inches in length of the femur had been lost in each limb, and to that extent the trousers which had been worn before the accident were now tucked up. He had lost exactly two inches in height: this was proved by measurements which had been taken before he left England.

On the 17th of January Mr. Clover administered an anæsthetic, and I proceeded with Mr. Balkwill to operate on the right knee by destroying some adhesions, Dr. Wilson and others being present. Some adhesions were ruptured, but the knee was not fully bent. The limb was afterwards firmly bandaged. Half an hour after the operation the patient was free from pain, and at night he slept well without an opiate. These operations were repeated on five occasions.

On January 23rd I operated on the left knee, but finding that the adhesions were too strong to be overcome by the unaided hand, I used the instrument indicated at p. 49. As soon as the limb began to be flexed I became aware that the muscles on the anterior surface of the thigh-bone were adherent at the seat of fracture, and it was necessary to use the instrument with considerable care to separate these adhesions at the same time that those in the knee-joint were destroyed. After seven applications of the instrument, however, at intervals of seven days, I succeeded in gaining such an amount of motion that the leg could be bent upon the thigh beyond a right angle, and the patient could walk up and down stairs.

Except immediately after the operation there was no pain, nor was there at any time swelling of the knee itself nor of the thigh.

Passive motion was continued until the entire and free use of both knee-joints was re-established, so that at length he was able to walk as well as though he had never met with an accident, and he could run freely. Also, he recovered his grip perfectly, so that he could ride a strong artillery horse.

In August he went out to India.

When I first saw this patient, in January, 1877, he was pale and attenuated, scarcely able to move about, suffering a good deal of pain, with nausea and loss of appetite. And during the whole of the time that he was under treatment he seldom took any other food than in a liquid form, such as milk, especially koumiss, and strong soups.

In July he had not only recovered the use of his limbs, but also his appetite had returned, and he looked robust. A greater change to health and activity from that which he presented in January I have never seen.



CASE 3.—*Anchylosis of the shoulder, the elbow, the wrist and the fingers.*

M. M. M—, aged thirty-four, in July, 1876, was driving at Brighton, when the carriage was upset. She was much bruised; especially the left shoulder, the arm, and the hand were injured. The coracoid process was fractured and the entire limb was greatly bruised. This bruising resulted in anchylosis of the shoulder, the elbow, the wrist, and of the ring and little fingers, of which all the joints were anchylosed.

On the 6th of October, Mr. Clover and Mr. Balkwill assisting me, anæsthesia was induced, and we separated the adhesions of all these articulations. Passive motion was continued until November 10th, when it was discontinued on account of illness in the house, so that the limb was a good deal neglected until February 17th, 1877, when Mr. Clover again administered an anæsthetic. Complete and free motion was now obtained of every joint, except of the proximal joint of the little finger. On November 7th we again induced insensibility, and broke through the adhesion. It was of the densest kind, and was so strong that it seemed like breaking through the bone. The adhesion was distinctly fibrous and yielded with a loud report. This lady has since had the ample and free use of her arm, and the operations were followed by such complete success that there is no trace of the injury, nor would it be suspected that there had been anchylosis of any joint.

CASE 4.—*Anchylosis of the hip-joint.*

C. M—, an officer in the Royal Engineers, was returning from the trenches before Sebastopol, on the 24th of November, 1854, with a friend, when he was wounded by a bullet striking him in the median line of the abdomen, immediately below the umbilicus. In this position the ball struck on a button, and, glancing, entered about three

inches above the pubes. It passed into the groin, carrying with it portions of a match-box and fragments of coins which were in his friend's pocket, and through which the ball passed to its destination. The ball lodged deeply in the upper part of the thigh, just below Poupart's ligament, displacing the femoral vessels outwards. An abscess formed, but the ball was not dislodged. Inflammation extended to the hip-joint, and confined the patient to bed, with scarcely any power of movement, until April. It was then discovered that the limb was fixed at an obtuse angle, and that the joint was stiff.

It would be tedious to follow this patient in his wanderings during the years 1855 and 1856. Suffice it to say that he sought the advice of the most experienced surgeons in London and in Paris, and tried baths innumerable in the South of France and elsewhere. The result of all this was that his health improved, but the limb remained as immovable as before.

When he placed himself under my care, in the following year, namely two and a half years after the injury was induced, I found the thigh immovable at the hip-joint and flexed at an obtuse angle, so that when he stood upright the toes were two inches from the ground.

He was tall and muscular, and very naturally felt that the loss of motion in the hip-joint put an end to his career in the army. He was willing to submit to any operation which offered a probability of the restoration of mobility.

On the 30th of March, chloroform having been administered by Dr. Snow, the pelvis was firmly fixed, and, with the assistance of Dr. Gibb, I endeavoured to flex the thigh. After some effort, a band of adhesions yielded, but the joint was not free. A renewed effort was made, and the remaining portion of adhesion was ruptured with a loud snap; when the joint-motion was immediately perfectly free and smooth. The limb was immediately afterwards encased in a gutta-percha splint, which had been previously moulded to the thigh. Pain was felt, both in the hip and

in the knee, on recovering from the effects of the chloroform; but this soon subsided and he slept well the same night without an opiate. After this time, pain was only felt on moving the limb. He left his bed on the seventh day, and motion of the limb was commenced one week later. Passive motion of the limb occasioned pain in the neighbourhood of the hip-joint. This pain was attributable to the presence of the ball, which was painfully felt whenever motion of the joint was attempted, rather than to the condition of the joint itself. Indeed, so much pain was caused by the position of the ball that it became a question whether an attempt should not be made to remove it. It was determined that this should be done, and I visited him prepared to remove the ball, when, happily, through the increased motion at the joint, the ball became displaced from its position, and gradually it ceased to be felt.

At the end of the third week he could bear the entire weight of the body on that leg. Motion was slow in being acquired, and a powerful effort was necessary to overcome the largely developed muscles of the thigh, which became rigid on making the least attempt to move the limb. However, by great perseverance in the use of passive motion the thigh could, at length, be flexed beyond a right angle, and it could be perfectly extended.

#### CASE 5.—*Anchylosis of the elbow-joint.*

S. D—, when three years of age, was jerked up from the ground by his nurse, who held him by the forearm. Inflammation of the elbow-joint was thereby induced, and anchylosis took place.

Five years later he was brought to me in November 1856.

I found the forearm extended, and the hand in a semi-prone position. The limb was somewhat atrophied, and the elbow was motionless.

Chloroform was administered by Dr. Snow, and I

endeavoured to flex the arm. The joint gradually yielded without imparting a distinct sensation of tearing, and moderate force was continued until the arm could be fully flexed and extended. The radius, however, could not be rotated; and, although a prolonged effort was made for this purpose, it seemed to be useless. The arm was therefore enveloped in a wet bandage, and placed in a splint at the same angle as before the operation. Scarcely any pain was felt after the operation. The patient slept well, without an opiate; and on the following day the joint was not painful, except under pressure.

On the following day the forearm was moved upon the arm slightly, without exciting pain; and these movements were continued on alternate days, for a week, when he was again placed under the influence of chloroform. Now, with a very slight effort, the radius could be rotated perfectly: the adhesions yielded immediately. Cold was again applied, and the arm was encased as before. No inflammation followed. After some few days passive motion was recommenced, and in a very short time the arm could be perfectly flexed and extended. Two months later, voluntary motion was almost perfect, so that the forearm could be flexed beyond a right angle. The movements of pronation and supination were limited.

CASE 6.—*Anchyllosis of the hip-joint.*

F. C—, twenty-five years of age, an officer in the army, suffered, whilst he was stationed in Ceylon, from gonorrhœal rheumatism, in 1855. He was confined to bed during many weeks, and suffered excruciating pain. Several joints were inflamed, as the shoulders, the knee, the hip, and the ankle, but all recovered well except the hip. The effusion around the hip was more than about any other joint, and the swelling was so great that it was supposed suppuration would take place. Swelling, however, at length subsided, and it was then discovered that the motion of the joint was lost. He returned to England some few months later, and consulted Sir Benjamin Brodie, with a view to



regain the mobility of the joint. No hope was held out that mobility could be restored, but, on the contrary, he was assured that he must take his "stiff joint with him to the grave;" and in consequence he abandoned all hope of accomplishing his object. He was unable to perform his military duties, and therefore made arrangements to quit the army. On the 22nd of January, 1857, Dr. William Wood brought him to me. I found both lower extremities of the same length; the head of the femur in its normal position; the buttock much flattened, and the limb slightly wasted. The thigh was completely extended, and there was no power of flexion, nor of motion, at the hip-joint, except a very slight (just perceptible) lateral motion. This motion, slight as it was, was sufficient indication that the adhesions were fibrous; and I gave an opinion in accordance with this view, and stated that the adhesions might be ruptured, and that mobility might be restored. He was about to proceed with troops to Canton, and was anxious that the operation should be performed before he went on board ship. I wished to have the power of watching him for six weeks after the operation; but he was unable to promise this, as it was doubtful when he might receive orders to embark. With Dr. Wood's sanction, the operation was, therefore, deferred until his return from China. Ten days later he embarked, expecting to leave the port on the following day, when an order was received to detain the vessel for three weeks. He immediately obtained leave of absence and returned to London. The operation was done on the next day but one following, namely, on the 3rd of February, Drs. Wood and Partridge and Mr. William Pile being present, and kindly lending their assistance.

Chloroform having been administered by Dr. Snow, I fixed the pelvis with one hand, and with the other jerked the limb, using very slight force two or three times, when the adhesions yielded and gave way gradually, allowing the thigh to be flexed to its full extent. A gutta-percha splint, which had been previously prepared, was

then applied, and the limb was bandaged. Our patient could, with difficulty, believe that any operation had been done, for he had no pain. Slight tenderness was felt in the course of the evening, but he slept well without an opiate. After four days the thigh was slightly flexed and extended. After two more days the splint was discontinued. The limb was now moved every day, and soon extended movements could be borne. A stick was at first used for support in walking about the house, but it was soon discontinued, for he could walk firmly and without lameness. Beyond the house, however, a stick was used for some weeks. Before three weeks had elapsed he had walked two miles from his house, namely, from Bryanston Square to Trafalgar Square and back. I was alarmed when I heard what had occurred, and feared for the result; but, happily, no harm was done. Some slight tenderness of the joint and rigidity of the limb followed, but it passed away rapidly, and after twenty-four hours the motion of the limb was as perfect as before. Six weeks after the operation the thigh could be flexed voluntarily beyond a right angle, and it could be abducted to within one inch of its normal range of motion. To show how sound the joint had become, I may mention that our patient could sit on his heels, each heel being equally in contact with the corresponding tuberosity of the ischium.

Two months after the operation, this case was read before the Royal Medical and Chirurgical Society, namely, on the 24th of March, and by his own desire this gentleman was present. Many then had an opportunity of seeing him walk, and some also were there who were well able to judge of the change which had been effected, having seen him previous to the operation. He walked without the slightest halt and without artificial support, and had regained the entire use of the limb; so that it was impossible to distinguish that the motion of one hip-joint was in the slightest degree inferior to the other.

On the 24th December, I received a letter from him,

from which I quote the following sentences:—"I walk occasionally twelve or thirteen miles a day. The buttock has filled out wonderfully."

He was then, and had been for some months, performing his military duties. He had gained his promotion, and had no longer any intention of leaving the army.

Sir Benjamin Brodie wrote me a very kind letter expressing his satisfaction on learning the result of the operation.

CASE 7.—*Anchylosis of both hip-joints, both knees, and the jaw.*

W. E.—, aged twenty-three, July, 1859. Four years ago, having exposed himself to the infection of gonorrhœa, the urethral discharge appeared on the seventh day, and it was followed in a fortnight by pain and swelling in the knee-joints. This inflammation about the knees lasted for two months, when it entirely ceased and he recovered the use of his limbs. The gonorrhœa also ceased, having yielded to cubebs in the course of three weeks.

Two months after the articular inflammation had ceased, he was again attacked; and on this occasion with more violence.

At this time, the right temporo-maxillary articulation first became inflamed, and later other joints in the order in which they are here mentioned; namely, the ankle, the knee, and the hip of the left side, the right hip, ankle and knee, both thumbs, both elbows, and both shoulders.

The joints of the upper extremities recovered well, without any results of inflammation being left behind; but the jaw remained stiff, as well as both hips and both knees. During the continuance of the inflammation, the right hip and the left knee were more painful than the other joints; but the right knee was much more swollen than the left, and the right hip was more swollen, as well as more painful, than the left hip.

The jaw could be moved to the extent of one eighth of an inch. The left knee, also, could be slightly moved—



just sufficient to alter the angle; but the leg could not be extended, the hamstring muscles being contracted. In the other affected joints there was no appreciable motion.

Such was his condition, when it was suggested by Dr. William Clark that he should consult me.

I had the advantage of meeting Sir William Gull and Sir William Fergusson in consultation. It was agreed that the rupture of the adhesions offered the only means of restoring mobility. It was, therefore, resolved to operate on the left hip-joint.

For this purpose we met on the 4th of August.

The limb being slung, chloroform was administered by Mr. Clover, and the adhesions being made tense, I placed my right hand beneath the lower end of the femur, and using one hand only and with very slight muscular force I attempted to move the limb in the direction of flexion. The adhesions yielded instantly, and with a loud snap, almost like the fracture of bone, and the motion of the joint was forthwith free. The joint motion was perfectly smooth, and the limb could be flexed and extended, and rotated inwards and outwards.

There was no pain after the operation, so that our patient could not, for some time, be persuaded that anything had been done, and could only be convinced of it by being allowed to move the limb. This he did readily, and immediately flexed the thigh upon the pelvis, and without assistance turned over on to his side, a feat which he had not been able to accomplish since his hips had been ankylosed.

Some few days before the operation was performed, an attempt had been made in this metropolis to effect the same purpose. It was not successful, and it was therefore concluded that consolidated bony union had taken place. I refer to this circumstance to show the importance of overcoming completely the power of the voluntary muscles. This had not been done. Hence the failure which occurred.

Four days after the first operation, namely, on the 8th



of August, there being no pain in the hip, the same gentlemen being present as on the previous occasion, we proceeded to separate the adhesions of the left knee also.

Anæsthesia having been induced, the adhesions were ruptured almost without an effort, so easily was it accomplished. There was not any sensation of pain in the knee at any time after the operation.

As the contraction of the hamstring muscles could not be overcome otherwise, it was determined that the tendons of the biceps and of the semi-membranosus and the semi-tendinosus muscles should be divided. This was accordingly done. On the 31st of October gradual extension was subsequently employed until the limb was entirely extended.

In the course of two months the motion of this joint was perfect.

Gradual extension was also used for the jaw, pressure being made on the incisor teeth. The instrument with which it was made consisted of a wedge with two blades, each blade being very accurately adjusted to the inclination of the teeth, so that, in separating the jaws, the blades of the instrument still continued to act in the direction of the inclination of the teeth.

The mouth was opened to the extent of one inch in the course of a fortnight. It was then opened fully under the influence of chloroform. There was great difficulty, however, in keeping the mouth open wider than one inch for longer than half an hour, the masseters and the temporal muscles becoming then very painful, and the flow of saliva being distressing; but with very moderate use of the instrument (for half an hour in the day), the mouth could be freely opened at all times to at least one inch in extent.

Some of the adhesions in this case were singularly unyielding, and they were consequently thought to be osseous. Greater success, perhaps, attends the rupture of adhesions which are consequent on urethral rheumatism than when

they depend on any other form of inflammation whatever.

Whilst anæsthesia was being induced Sir William Ferguson remarked, "I was present at the operation which was attempted two or three days since and used all the muscular force of which I am capable, and you see I have a strong hand. It is certain that bony union has taken place, and that you also will fail in your attempt." And when he heard the loud snap, for he was standing at the foot of the bed, "Ah!" he cried, "you have broken the femur." And I admit that it sounded like it. But still supporting the lower end of the femur with my hand, I could feel that the bone was intact, and that the head rotated freely in the acetabulum. And so, without speaking, I placed the limb in his hands. "Excellent," he exclaimed, "I never believed in your cases before; but I shall never disbelieve them in future."

The rigidity of the muscles constitutes the greatest, and almost the whole difficulty in the restoration of motion in cases which follow urethral rheumatism. The hot-air bath relieves the pain induced by motion, as well as the rigidity of the muscles themselves, and more effectually than any other remedies. Chloroform liniments are useful; and the inhalation of chloroform enables such limbs to be moved with entire freedom. But the hot-air bath may be used daily with great advantage, until the functions of the limbs are entirely restored.

#### CASE 8.—*Anchylosis of the finger.*

S. M.—, aged twenty-three, contracted gonorrhœa, and the discharge appeared on the eighth day after infection. Ten days later he observed that the middle joint of the ring-finger of the left hand was stiff and swollen; but, as it was not painful, he did not give it special attention for some days. He went to bed, the hand being perfectly well, and the joints flexible, and on waking in the morning he found the joint as I have stated. Sir William

Gull saw him, and, subsequently, my opinion was asked with regard to the restoration of mobility.

I found the middle joint of the ring-finger flexed at a right angle: the finger could not be further extended, but it could be perfectly flexed into the palm of the hand. The flexor tendon was rigidly contracted. Motion was stopped so suddenly at a right angle that more than one surgeon who had seen the case, as well as an excellent and much-esteemed physician, recommended non-interference, since it was probable, as they thought, that osseous depositions prevented further movement. It is on account of this opinion that I relate the case here to show how guarded should be the judgment until anæsthesia has been induced.

I recommended forcible extension, with or without division of the tendon, as might appear to be necessary at the time.

Sir William Gull concurred in this view, and consequently we met to carry out this purpose on the 14th of May, 1860.

Chloroform having been fully inhaled, I endeavoured to extend the finger, and for this purpose used as much force as I deemed justifiable—much more indeed than is usually necessary; but as it was not sufficient, I desisted, and divided the tendon, and again attempted to extend the finger. Now, the adhesions yielded readily, and only slight force was required. Little or no pain followed the operation; and in a fortnight, passive motion was perfect. It required, however, longer time to regain the action of the flexor muscle.

#### CASE 9.—*Anchylosis of the elbow-joint.*

E. G.—, who had been in China, and there had suffered from urethral rheumatism and inflammation of several joints, and among others of the left elbow, was recommended by Mr. Henry Lee to consult me. All the other affected joints had recovered perfectly, and there was not any stiffness left except in this one; but the elbow re-

mained ankylosed. Immediate flexion was employed while he was under the influence of chloroform, and within one month he left London to return to China, having recovered complete power of flexion and of extension of the forearm. The muscles, however, were still feeble, and needed use to develop their power. Three years later I met him accidentally in London and inquired after his elbow. "It is perfectly well," he said, at the same time moving his arms vigorously. "Indeed," he added, "I have entirely forgotten which was the stiff elbow: both arms are now exactly alike." On examining, I could not distinguish any difference between the two elbows.

CASE 10.—*Anchyllosis of the shoulder-joint.*

J. H.—, aged twenty-four, having contracted gonorrhœa, in the course of a fortnight suffered from rheumatic pains in the left knee and in the right shoulder. The pain in the shoulder was extremely slight; so much so that she would have overlooked it, had not the joint gradually become stiff. For this stiffness of the shoulder she consulted Mr. Gerrans, and he brought her to me.

I found the shoulder ankylosed in such a position that the arm was immovably fixed by the side; that is to say, all motion at the joint was lost, and motion of the limb together with the scapula alone remained. The deltoid muscle was very much atrophied, and the pectoral muscle was retracted. The knee, however, was perfectly flexible; but for many months it remained subject to occasional pain and swelling.

On the 15th of October, 1860, Mr. Gerrans administered chloroform and I ruptured the adhesions. They were soft, and required scarcely more force to separate them than was necessary to raise the arm. The joint was instantly free. The pain that followed this operation was most trivial. On the following day the bandage was discontinued.

Five days later, free motion was found. It needed,



however, considerable time to restore the condition of the muscles of the arm.

This case presents no point of special interest except the fact of urethral rheumatism in the female. I am not aware that another such case is on record. It is even denied that the female is subject to this form of disease. It is difficult, in these cases, to elicit the whole truth; and this is, probably, the reason why similar cases have not been recorded.

CASE 11.—*Anchylosis of the hip-joint.*

H. C—, when nine years of age, suffered from inflammation of the hip-joint after exposure to cold. Great pain was experienced, with effusion about the articulation. This lasted for many months and terminated in complete loss of motion.

I saw him first in November, 1856, when he was twenty-one years of age; and found the limb much atrophied and one inch shorter than the other, and the pelvis very oblique, so that the heel was four inches from the ground. The head of the femur remained in the cotyloid cavity. There was not perceptible motion at the hip-joint; but the sensation communicated to the hand on attempting to move the limb indicated that the adhesions were fibrous. The cicatrices of former abscesses surrounded the joint.

On the 20th of November, being assisted by Sir Duncan Gibb and by Dr. Trouncer, I endeavoured to flex the thigh upon the pelvis, chloroform having been administered and the pelvis having been firmly fixed. With a very slight effort the adhesions snapped audibly, and flexion and extension of the limb were immediately perfect. He recovered from the effects of chloroform almost as the mouth-piece was removed, and immediately leaped from the bed on which he was lying and rushed into the next room, where his father was sitting, using the hip-joint in the most natural manner. A gutta-percha splint was subsequently applied to keep the joint at rest. Very slight pain

followed the operation, and in the evening he was entirely free from pain. He slept well during the night without an opiate. On the third day the splint was discontinued and the limb was slightly moved: there was no pain about the joint. After ten days he could bear the limb to be flexed at a right angle. Power was gained rapidly, so that in the course of a month the thigh could be raised, unassisted, beyond a right angle with the trunk. In January he walked freely, with the support of a stick, the sole of his boot being raised one inch.

When I last saw him, about a year after the operation, he could walk three miles without fatigue, and he walked that distance almost every day. He carried a stick, but he did not use it in walking.

CASE 12.—*Anchylosis of the hip-joint.*

F. S—, when seven years of age, suffered from strumous disease of the hip-joint. Abscesses formed and broke at various points down to the middle of the thigh, and adhesions formed, which prevented all motion at the joint. The limb was in such a condition, large portions of bone having come away, that the restoration of motion in this joint was not thought of. But the knee of the same side had also been inflamed, and abscesses had formed and burrowed around the joint, and had opened in front and behind and on all sides, and contraction had taken place of the hamstring muscles, so that the knee was fixed nearly at a right angle. When she had attained twenty-three years of age, Mr. Chalk asked me to see her with him. We met on the 21st of May, 1857.

When I perceived what was the condition of the knee-joint, it occurred to me to examine also the hip. The hip was motionless, and having been so for twelve years or thereabouts, no hope was entertained by her friends of restoring the motion of the joint. On examination, however, it was clear that the adhesions were fibrous; so we determined to divide the hamstring tendons, and to examine the hip whilst she was under chloroform.

Dr. Snow administered chloroform, and, with scarcely more force than was necessary for the examination of the hip-joint, the adhesions were ruptured. No pain was felt at any time after the operation; and without any further attention the entire motion of the joint was re-established.

CASE 13.—*Anchylosis of the hip-joint.*

L. S—, in 1853, when ten years of age, was attacked with inflammation of the hip-joint. She was seen by a surgeon in the neighbourhood of the metropolis, and was actively and judiciously treated. Pain, however, was scarcely alleviated by the treatment; there was great suffering, the nights were passed without sleep, and the health was seriously impaired.

I first saw her in March, 1856. Pain had then entirely ceased and had not been felt during the preceding four months. The hip-joint was fixed and without motion, at such an angle that, standing upright, the toes of the affected limb just touched the ground, the heel being raised; the pelvis was oblique and the spine was slightly curved; there was flattening of the nates, and the limb was wasted: it was, however, by measurement, of the same length as the other limb.

Having fixed the pelvis with one hand, I flexed the thigh, jerking the limb without using much force. The adhesions were soft, and yielded readily. Very slight pain followed the separation of the adhesions. A gutta-percha splint was applied, and it was not removed for eight days; at the expiration of which time passive motion was instituted. At first, gentle movements only could be borne; but they were gradually increased, until the limb could be perfectly flexed and extended.

For six weeks after the rupture, there was scarcely any voluntary power of flexion of the thigh, notwithstanding that tenderness on motion had ceased. From this time, however, motion began to increase, so that in the course of another six weeks there was considerable power of

voluntary motion. Obliquity of the pelvis was in great measure overcome, and the sole of the foot was in contact with the ground. The foot could now be thrown well forward in walking.

Five months after the operation the thigh could be flexed without assistance beyond a right angle, and it could be fully extended; the pelvis had regained its horizontal position, and the foot could be well flexed in walking.

In March, 1857, this patient walked with a stick, but firmly.

In March, 1858, in regard of size and firmness, the two limbs were nearly equal; the nates, also, had nearly regained the normal size. A stick was used for support when she walked to some distance from home, but in the house it was no longer used. All the motions of the hip were perfect, and they could be employed unaided, except extreme flexion of the thigh. This thigh could not be flexed so perfectly as the other. Towards the end of this year a stick was no longer used.

I had an opportunity of seeing this patient in September, 1860. There was then scarcely any difference between the two limbs. The muscular power was perhaps not quite equal; but motion at the hip-joint was perfect.

CASE 14.—*Anchyllosis of the knee-joint, with displacement of the tibia backwards.*

A. M.—, fifteen years of age, a healthy-looking boy, from the north of England, was placed under my care in the spring of the year 1854. In 1844 he suffered from strumous inflammation of the knee-joint. Abscesses formed, which remained open during many months, and at length closed, leaving numerous cicatrices.

I found the leg flexed at an acute angle; the tibia slightly displaced backwards; the knee-joint covered with cicatrices, some of which were adherent to the patella, and some to the spine of the tibia; with just appreciable motion at the joint. The patella was not adherent to the femur.

Assisted by Dr. Edmund Waller, I divided subcutaneously the hamstring muscles, portions of tense fasciæ,



and the adherent cicatrices, and after one week I extended the limb gradually. The limb, however, was only partially straightened by this gradual extension, and, as the adhesions appeared to be firm and unyielding, I proposed to rupture them. Before this was done, however, I sought the advice of my colleague, Mr. Lonsdale. Mr. Lonsdale thought that, as a last resource, rupture might be had recourse to; but before he sanctioned it, he was desirous of seeing that nothing more could be gained by gradual extension. This having been proved beyond doubt, the tendons, fasciæ, and cicatrices were again subcutaneously divided, and eight days later Dr. Snow gave chloroform, and the leg was flexed upon the thigh. The adhesions were wholly fibrous, but exceedingly solid and tough, and it required some force to separate them. The limb was then again placed in the splint at the same angle as before. Cold was applied to allay pain, and at night he slept well without an opiate. After this time no pain was felt.

On the third day extension was recommenced, and it was continued until, at the expiration of two months, the limb was perfectly extended; and when extension was complete chloroform was again administered, and the leg was flexed freely, and passive motion was repeated each day as it could be borne. At length the limb could be bent at a right angle, and it could be perfectly extended. This amount of motion, however, caused considerable pain, so that the patient himself was unable to flex the limb to this extent. He enjoyed, however, a range of motion which he could employ unassisted, and which was more than sufficient for the ordinary movements in walking. When so much freedom of the joint had been gained, Mr. Lonsdale again saw him and expressed his satisfaction with the progress of the case. The first operation in this case was performed in April, 1854, and the second at the end of August of the same year.

In 1856, I again had an opportunity of examining the

limb. It had increased much in size; the muscles of the thigh and the leg were much larger than formerly, though the limb was still considerably smaller than the other. The motion of the joint had diminished somewhat in extent, yet useful motion remained. A stick for support was only used when he left the house.

In 1858 he walked well and easily without a stick.

CASE 15.—*Anchylosis of the hip-joint.*

A. G.—, seven years of age, a small, ill-nourished child, had suffered for two years before I saw her with acute inflammation of the hip-joint, which was thought to be rheumatic in character: it followed exposure to wet and cold.

This child was brought to me in June, 1853. The thigh was flexed at a right angle with the trunk, and it was immovable. Under the influence of chloroform, just perceptible motion could be obtained. A jerk ruptured the adhesions with an audible snap, when the entire range of flexion and extension was immediately gained. Some pain was felt during that and the following day, to allay which opiates were given. Afterwards, pain was felt only when the joint was moved. This tenderness lasted for ten days. After this time the limb was moved every day, and each day more motion was gained. Also, the child was encouraged to move about the house, that the limb might thus be brought into action. Voluntary power was gradually regained; but the limb remained feeble during many months.

In this instance the limb was much wasted, but it remained of the same length as the other limb. Infantile paralysis was superadded to rheumatic inflammation, and some of the muscles, especially the extensors of the leg, were feeble.

After treatment for two years, the thigh could be raised beyond a right angle with the pelvis, the leg could be thrown forward in walking, and a stick only was used for support.

August, 1857.—The limb had almost recovered its normal size; the nates had filled out, though there was still slight flattening; the motions of the hip-joint were perfect; and in walking about the room feebleness was not observable. After taking more than slight exercise, however, drooping of that side was apparent. No support for the limb was used.

CASE 16.—*Anchylosis of the hip-joint.*

H. K.—, aged sixteen, in the spring of 1857, having lain in the wet grass, suffered with rheumatic inflammation of the hip-joint. I saw him on the 16th of March, 1858, together with Mr. Cock and Dr. Braxton Hicks.

There was not any perceptible motion at the hip-joint; the buttock was slightly flattened; the heel was raised one inch from the ground; and the limb was wasted.

On the 28th chloroform was administered, and on flexing the limb the adhesions were readily snapped.

Some pain was felt after the operation, but it soon subsided, and was not again felt except when the joint was moved. There was so much rigidity of the muscles of the thigh that motion was unusually painful, yet he was able to ride on horseback a distance of twelve miles without leaving the saddle, and on dismounting had no pain whatever in the limb. He did not, however, gain all the advantage of the operation that he should have done, from want of perseverance in passive motion.

CASE 17.—*Anchylosis of the hip-joint.*

J. M.—, an officer in a cavalry regiment, early in the year 1854, in India, joined a shooting party, and having been for some days on marshy ground, was attacked with rheumatism, and had to be carried home. He remained confined to his bed for three months, suffering acutely, and unable to change his posture during the early period of his illness. A large bed sore formed over the sacrum, and effusion was so great around the hip that suppuration was feared. Happily, however, swelling subsided,

but it was found, when motion was at length attempted, that the hip was fixed and immovable. Several months elapsed before he was able to resume his regimental duties, and then he found the fatigue of walking excessive, and his seat in the saddle most insecure. He also suffered excruciating pain on dismounting. These circumstances induced him to return home, for which he obtained leave.

On the 5th of March, 1857, he walked into my room, leaning on a stick. I found the thigh fixed in the extended position, and immovable at the hip-joint; the extremity of the same length as the sound limb, and the pelvis slightly oblique. I proposed to give chloroform, and to rupture the adhesions at the same time, should they be found to be fibrous. To this he assented, and the following day was appointed for the examination.

Chloroform having been administered by Dr. Snow, the pelvis was firmly fixed, and it was immediately apparent, on raising the leg, that the adhesions were fibrous. A jerk in the direction of flexion was sufficient to separate them, and the rupture took place with an audible snap. The joint was immediately free. The limb was then bandaged and encased in a splint, and it was allowed to remain undisturbed for five days. Very slight pain was felt after the rupture, so that opiates were not required. On the sixth day passive motion was commenced. Only very gentle and limited movements were at first permitted; for movement caused pain. This tenderness, however, soon ceased, or the pain was not more than could easily be borne, and the splint was discontinued on the fourteenth day. After six weeks the thigh could be raised unassisted to a right angle with the trunk, and the limb could be fully extended: extension was executed slowly, but flexion by twitches rather than by a steady muscular action. The obliquity of the pelvis was entirely removed. The patient could walk without limping and without support for some steps; he could also sit flat on a chair, and he could even straddle across a chair, sitting in the centre of the seat; but both of these positions were painful, and the latter



could only be borne during some seconds. Passive motions, especially flexion and abduction, were continued for several months. After that time he could mount his horse easily, and could remain in the saddle, as he said, "any number of hours," and without experiencing pain on dismounting.

CASE 18.—*Anchylosis of the elbow-joint.*

G. H—, aged twelve, had suffered from rheumatic inflammation of the right elbow, which had terminated in entire loss of motion. Inflammation commenced six months before I saw him in 1858, and inflammatory action had entirely ceased when he was brought to me. The arm was flexed at an acute angle, and the elbow-joint was perfectly stiff.

With a brisk movement of flexion, and afterwards of pronation of the forearm, free movements at the elbow were obtained. On the following day, passive motion could be borne, no pain having been felt after the separation of the adhesions. Motion, however, was slow in being restored. A dumb-bell was used in the hand, to enable him better to move his arm, the elbow being supported on the table. After four months, an abscess formed on the posterior surface of the elbow, which I feared was connected with the joint itself, in consequence of the synovial secretion, and the large amount of it which flowed from the wound. It was, however, probably connected only with the bursa on the posterior surface of the elbow, and inflammation was probably occasioned by the pressure on the elbow in moving the joint, as I afterwards heard that this was frequently done with the bare arm on the table and without an intervening pad. The abscess soon healed, and the motion of the joint afterwards improved rapidly. The only mark of difference now between the two arms is the small cicatrix of the abscess. One arm is as strong as the other, and the anchylosed elbow has entirely regained its normal range of motion.

I relate this case with much satisfaction, for it is rare to gain such a perfect result in a ginglymoid articulation.

These operations are usually more successful in the ball-and-socket, than in the ginglymoid, joints.

CASE 19.—*Anchylosis of the knee-joint, with genu valgum.*

T. F—, aged seven, 1877, had been struck on the knee a year previously, and the blow gave rise to considerable pain; but this subsiding he soon ran about again, and it was only in the evening of the same day that swelling was observed. Abscess formed, and pus was discharged during a twelvemonth. Favorable medical reports of the progress of the case were continually made, until one morning some doubt was expressed, and in consequence a consultation was held on the same day. It was considered necessary to open the joint, and perhaps to excise the ends of the bones, and perhaps even to amputate. This opinion being given, I saw the child on the following day, June 19, 1877. He was wearing a splint reaching from the buttock to the heel. Pus was passing out through several wounds on the outer side of the joint, and there was considerable thickening of the structures around and behind the joint. The wounds were all in the course of the biceps tendon. There was no exposed bone, but there were shreds of dead fascia in the wound. Also there was genu valgum, and an anchylosed joint. I advised that an opening should be made over the head of the tibia, where pus was collecting; to cleanse the wound; to divide the biceps tendon, and to break through the adhesions in the joint. This was agreed to, and Mr. Balkwill accompanied me into the country on the following day. In three weeks the wounds had healed; and in six weeks genu valgum was entirely overcome and the leg was straight. For six months passive motion was employed, and then the leg could be flexed voluntarily a little beyond a right angle. He wore an instrument for protection from the pelvis to the foot, with free joints, for sixteen months; and, as he then walked perfectly, it was discontinued. The joint motion was never increased beyond that mentioned. He could walk and

run, however, without the slightest halting or weakness. His mother kindly wrote out the entire case for me; but I have had to shorten her description.

In this instance there was no disease of the bony structures, and there never had been suppuration within the joint.

CASE 20.—*Anchylosis of the knee-joint.*

Towards the end of July, 1858, a lady brought her son to me from the neighbourhood of Oxford, with partial anchylosis of the knee-joint. He was twelve years of age. Four years previously, rheumatic inflammation had occasioned stiffness of the joint, and this terminated in anchylosis. The limb was slightly flexed, the hamstring tendons were rather tense, the limb was somewhat atrophied and one eighth of an inch shorter than the other. It was a case well fitted for operation, and I recommended it strongly.

In the first week of August the boy was again brought to me. I was astonished to see him, bending his knee, and walking with only a slight limp. The solution of the matter was thus:—On the previous day, whilst wrestling with his brother, he was thrown to the ground, and in falling bent his knee under him. He felt something give way in the knee, and was carried into the house. He had no pain, and presently was able to walk.

I found that almost the entire motion of the joint could be borne, and that scarcely more had to be done than to order a thicker sole to be added to his shoe.

✓ CASE 21.—*Anchylosis of the hip-joint.*

E. B.—, in 1853, when fourteen years of age, was seized suddenly during the night with severe pain in the right hip. The joint continued to be painful for eighteen months. Then pain ceased and he was again able to use the limb. The pain soon returned however, and the joint remained in a painful condition until Christmas, 1856. In April, 1857, he was brought up to London to consult

Sir Benjamin Brodie, and thinking that it was a fit case for rupture of the adhesions, Sir Benjamin very kindly sent him to me.

The thigh was flexed, so that the heel was three inches from the ground; the buttock was somewhat flattened, and there was slight motion at the hip-joint.

It appeared to me probable that the adhesions might be overcome, and that the limb might be extended by mechanical means alone and without the application of sudden force; and I consequently gained permission to try the effect of gradual extension before proceeding to operate.

In the course of three and a half months the limb was perfectly extended, and such a useful amount of motion was gained that it was not necessary to resort to more force. Passive motion and friction were employed to gain mobility, and before he left London he could use the limb very fairly. Motion caused very little pain, and it was, therefore, employed somewhat roughly after he returned home, in the hope that it would expedite the cure; and in consequence an abscess formed. But notwithstanding, when I last saw him, he enjoyed considerable power over the limb, with motion at the hip-joint.

#### CASE 22 — *Anchyllosis of the hip-joint.*

A. B.—, in 1850, when five years of age, after sitting on the damp grass, suffered from rheumatic inflammation of the hip-joint. Abscess formed around the joint, which broke and healed at various points; and subsequently contraction took place, and the limb was rendered immovable.

When she was nine years of age I saw her. The thigh was flexed upon the pelvis, the foot being raised eighteen inches from the ground; an abscess in the neighbourhood of the trochanter discharged a small quantity of pus; very slight motion remained at the hip-joint, and attempts at motion excited pain.



Gradual extension was employed, and it had been carried only to a slight extent when the abscess healed. Extension of the limb was continued, and flexion was in great measure overcome, but the limb could not be entirely extended, in consequence, as it appeared, of contraction of the tensor vaginae femoris muscle, as well as of some cicatrices in its immediate vicinity. With the concurrence and assistance, therefore, of Mr. Scannell and Mr. Mould, I divided the muscle at its origin, as well as the cicatrices subcutaneously, and again, after some days, when the punctures had healed, extension was recommenced. All difficulty seemed now to be removed, and the limb was soon fully extended. Passive motion afterwards completed the cure, and I had the satisfaction of knowing that, before twelve months had expired from the commencement of the treatment, the child was able to walk well and firmly with the aid of a stick.

The limb was somewhat shorter than the other; but it was strong, so that exercise could be taken freely, a slight addition being made to the sole of the boot.

CASE 23.—*Anchylosis of the knee-joint.*

J. N.—, fourteen years of age, of a healthy aspect and a dark complexion, was placed under my care in July, 1855.

When he was five years old he suffered severely from scarlatina, and had not recovered when his knee became inflamed; abscess formed, which, burrowing, surrounded the joint, and discharged itself at various points. Numerous adhesions formed, and the flexor muscles became contracted, and subluxation of the tibia resulted. The limb was atrophied; the knee was bent at a right angle, and there was just appreciable motion at the knee-joint.

I divided the hamstring tendons and some tense fascia, as well as several points of adhesiou; and a week later, the punctnres having healed, I ruptured the adhesions in flexing the limb, being assisted by Dr. Dick, and by Dr. Snow, who administered chloroform.

In consequence of the extensive adhesions of the skin, it was not possible to liberate the joint entirely. The subluxation was entirely overcome, however, and the tibia was replaced in its normal position. Passive motion was then instituted, and considerable power of flexion and extension of the limb was gained. At the end of four months this patient could walk about the house without support.

He had, before coming to London, used a crutch for eight years, and had never walked without it.

In December, 1855, his limb was so strong that, on several occasions, he carried a gun on a Scotch moor for two or three successive hours, without injury to the joint.

CASE 24.—*Anchylosis of the maxilla.*

R. J.—, nineteen years of age, and of a strumous diathesis, had suffered from rheumatic inflammation of the hip, the shoulder, the ankle, and the jaw. He consulted me with Mr. Wolstenholme, in May, 1858.

Mobility had been restored to the limbs, but the right temporo-maxillary articulation, which was so far fixed that the incisor teeth could only be separated to the extent of one eighth of an inch, remained fixed. The masseter muscles were extremely rigid, especially on the right side, and in cold and damp weather the jaws were entirely closed.

We agreed to try the effect of gradual extension, by means of a similar instrument to that which is described in Case 6. The blades of the instrument, covered with india-rubber, were introduced with great difficulty between the teeth; but this having been accomplished, the jaws were readily separated, and in a short time the mouth was fully opened, the teeth being separated one and a half inch.

For a short time after the removal of the instrument from the mouth, the jaw could be moved, and mastication was easy; but muscular rigidity soon returned, and extension had in part to be recommenced. However,

in August, much power over the jaw had been gained; so, that, with a moderate daily use of the instrument, the teeth could be well separated. He left town during this month, and I did not see him again until five months had elapsed. I found that he had ceased to use the instrument, and that mobility had then diminished. The masseters were rigid. I recommended the subcutaneous section of at least the right masseter muscle, hoping that the other might yield when this had been done, and feeling assured that this was now the only impediment to free motion. This was not, however, acceded to.

The inconvenience which is suffered from ankylosis of the temporo-maxillary articulation is excessive. Nutrition is rendered defective, both through the difficulty of introducing solid food into the mouth and, also, of masticating it. Utterance is most imperfect; and, indeed, of some words, and parts of words, it is rendered impossible. Section of the masseter muscle is both simple and effectual; so that it is preferable to have immediate recourse to this operation, except in those cases where muscular retraction is slight, and where, consequently, it may probably be easily overcome.

CASE 25.—*Ankylosis of the knee-joint.*

J. R.—suffered from rheumatic inflammation of the knee-joint when he was twenty-three years of age, and remained under treatment during the following seven years; at the expiration of which time I was asked to see him. —He had been constantly seen by Dr. Metcalfe Babington, and occasionally by Sir Benjamin Brodie.

On the 22nd of November, 1857, I found the knee contracted at an angle somewhat beyond a right angle; the patella ankylosed to the outer condyle of the femur, and the hamstring tendons tense. There was scarcely perceptible motion at the joint, and there was apparently great pain, even when the limb was at rest. The patient himself was a dark-haired, olive-complexioned, excitable man.

It had been proposed on more than one occasion to



remove the limb, extension having been attempted without the slightest success, and the pain in the joint being intolerable. Very large doses of opium (as much as 90 minims of the tincture) had been habitually taken, to procure even some few hours' sleep; but this large quantity often failed even to soothe.

Such being the state of the case, it was agreed with Dr. Metcalfe Babington, and it was approved by Sir Benjamin Brodie, that the hamstring tendons should be divided, that gradual extension should be attempted, and that, this failing, the adhesions should be ruptured.

On the 25th of November, I divided the hamstring tendons; and on the 30th, the punctures having healed, gradual extension was commenced.

On the first night after the tendons were divided our patient was able to sleep without an opiate; the pain in the joint having been greatly relieved by the section of the tendons alone. And, as the limb was extended and the articular surfaces were separated one from the other, pain entirely ceased. No more opiates were given, and from this period the general health began to improve.

Gradual extension was continued for several weeks, when it was found that the leg could not be fully extended; so it was determined to separate the adhesions by flexing the limb.

On the 22nd of February Dr. Snow administered chloroform, and the adhesions were readily ruptured. Those, however, which connected the patella with the femur could not be separated by flexion alone, but needed other treatment, namely, separation with the perforator. The limb was placed in a somewhat more extended position than before, and the limb was as rapidly as possible fully extended.

He was well satisfied to have gained a useful limb, but he was even more pleased to retain his leg and to be free from pain.

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## CHAPTER V.

### BONY ANCHYLOSIS.

ANCHYLOSIS is said to be true, bony, or complete, when two articular surfaces are united by bone. They may be so united as to form a single bone, or bridge-like formations and osteophytes may be thrown out, perhaps in the course of the ligaments, to hold firmly together any two bones. The former condition is known as anchylosis by fusion, and the latter as anchylosis by circumfusion.

Anchylosis by fusion is rare, and seldom more than one joint is affected; but there are well-known examples of general anchylosis where fusion, more or less complete, has occurred. I have already mentioned an instance which came within my own knowledge where this occurred to a man in the prime of life. There is, also, a similar specimen in the Hunterian Museum; and there is another, of an old man, in the museum of Trinity College, Dublin. But the most curious of all, perhaps, is that mentioned in 'L'Histoire de l'Académie des Sciences,' 1716, of a child of twenty-three months, where anchylosis was complete of the entire skeleton.

Again, anchylosis is occasionally observed at birth. When it is a congenital affection it is the result of inflammation equally as when it occurs after birth, and the articular apparatus is then entirely absent; true anchylosis or synostosis always being induced. I have seen an instance in a boy of twelve years of age, in whom all the fingers of both hands were in this manner anchylosed: every joint was destroyed.

Thus, in bony anchylosis the articular ends of the

bones are united either by flattened ribbon-like, or by rounded projections of bone, which are formed in the course of the ligaments ; or, on the other hand, two bones are fused into one, and these conditions result from well-marked inflammation of the joint and from injuries around the joint. When suppuration has taken place, and the articular cartilage has been destroyed, the spongy tissue of one bone is continuous with that of the other ; but when bridge-like formations have occurred around a joint the cartilages, and even the synovial membranes, may remain for a time more or less unaffected. After long disuse, however, whether in a contracted or in an extended position, when the articular surfaces have remained for a long time in close contact one with the other, destruction of the cartilages and ankylosis by fusion will follow.

True ankylosis, then, may be straight or angular.

The joints in which ankylosis especially occurs are the hip, the knee, and the elbow ; and next in order to these are the joints of the hand and the shoulder. True ankylosis of the shoulder, however, is rare. Four cases have come under my care. It had been induced in each case by gonorrhœal rheumatism. In three cases it occurred on the right side. The position of the arm was natural, and in consequence of the increased mobility of the scapula there remained a most useful arm and hand ; and except in carving at table, the loss of the shoulder-joint would scarcely be observed. In all ordinary occupations it would pass absolutely unobserved. Nor have I seen an instance of ankylosis of the elbow in which it was advisable to interfere, union having always taken place at a convenient angle ; nor at the ankle, union having occurred at a right angle.

In bony ankylosis union may take place at such an angle as to be in the highest degree inconvenient. Under these circumstances this repair, which is intended to be permanent and useful, may fairly be made the subject of surgical interference.

It is only some few years since the following was the dictum of a much esteemed teacher of surgery. "Where a complete osseous consolidation has taken place, it may be set down not only as incurable, but as admitting of no improvement or alteration in the position of the limb ; and whatever that may be, the patient must be content with it."<sup>1</sup>

<sup>1</sup> 'A Dictionary of Practical Surgery,' by Samuel Cooper. Seventh Edition. Art. "Anchylolysis."

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## CHAPTER VI.

### TREATMENT OF BONY ANCHYLOSIS.

IN true ankylosis a sensation of solidity is communicated to the hand on grasping the limb, such as can only result from a continuity of bony structure. Also, the muscles which govern the articulation cannot be thrown into action when ankylosis is complete. Observing these conditions it is scarcely possible not to make a correct diagnosis. But, that there may not be room for mistake, anæsthesia should be induced before an opinion is expressed. When an examination is made under such conditions doubt can no longer exist. And if, under the influence of an anæsthetic, even the least movement is observed, or if, before the full influence is obtained, the muscles can be excited to action, synostosis is not complete. Occasionally these points can only be made quite clear when anæsthesia has been fully induced.

There are four operations which may, under varying circumstances, be done to restore mobility or to improve, the position of the limb—viz. 1st, the removal of a wedge of bone; 2nd, drilling subcutaneously through the new bony formation; 3rd, cutting through the bone subcutaneously to make a false joint; 4th, dividing the bone subcutaneously to restore the position of the limb.

1. It was proposed by Dr. Barton, of Philadelphia, to remove a wedge of bone, when bony ankylosis had taken place with much deformity, and thus to improve the position of the limb; and he performed this operation in 1835, on the person of a young physician, Dr. Seaman



Deas, of Alabama, whose knee was ankylosed at a right angle. The following is his description of the operation :

“Two incisions were made over the femur, just above the patella. The first commenced at a point opposite the upper and anterior margin of the external condyle of the femur, and, passing obliquely across the front of the thigh, terminated on the inner side. The second incision commenced also on the outer side, about two inches and a half above the first, and passing likewise obliquely across the thigh, terminated with the other in an acute angle. By these incisions were divided the integuments, the tendon of the extensor muscles of the leg at its insertion into the upper part of the patella, and some of the contiguous fibres of the rectus and crureus muscles themselves, a greater part of the vastus internus, and a portion of the vastus externus. A flap composed, therefore, of this structure was elevated from the femur, close to the condyles. The soft parts were next detached from the outer side of the bone, from the base of the flap towards the ham, by passing the knife over the circumference of it, so as to admit of the use of the saw. The flap then being turned aside, a triangular or wedge-like piece of the femur was easily removed by means of a small, narrow-bladed saw. This wedge of bone did not include the entire diameter of the femur at the point of section ; so that a few lines of the posterior portion of the shaft of the bone remained yet undivided. By slightly inclining the leg backwards these yielded, and the solution was complete.”<sup>1</sup>

The limb was supported on a splint at an angle corresponding to that of the knee previous to the operation ; and subsequently it was brought into nearly a straight position by using a series of splints with varying angles, until at length the limb could be confined in an extended position so long as it was necessary to produce bony union.

<sup>1</sup> ‘American Journal of the Medical Sciences,’ vol. xxi. 1837-8.

2. Professor Brainard,<sup>1</sup> of Chicago, proposed subcutaneous drilling and subsequent fracture as a substitute for the operation of Barton; and the operation succeeded perfectly in his hands, and also as it was performed by Professors Gross and Pancoast at the Jefferson Medical College. The mode of operation was as follows:

"Chloroform having been administered, a longitudinal incision, hardly one half of an inch in length, was made over the outer surface of the knee, near its middle, in a line with the groove between the head of the tibia and the external condyle, down to the two bones. Through this opening a steel perforator was introduced, keeping it as nearly as possible in the direction of the line of the articulation, and passing it on to the opposite side until the point could be felt beneath the integuments. The instrument was now moved about in such a manner as to cut through and break down the osseous adhesions between the femur and the tibia on the one hand, and the femur and the patella on the other. The union between the bones was exceedingly firm; but after much difficulty it was finally overcome, and by forcible extension of the limb, the parts yielded with a cracking noise."<sup>2</sup>

When it is desired merely to gain a better position of the limb, one or other of these operations may be performed in cases where bony ankylosis with great deformity has taken place.

3. The third operation is that of establishing a false joint after section of the bone. This operation also was proposed and performed by Dr. Barton,<sup>3</sup> of Philadelphia, on a sailor, John Coyle, aged twenty-one. Fracture of the femur had been followed by ankylosis at the hip-joint, and an angular union of the broken bone had resulted;

<sup>1</sup> 'On a new method of treating Ununited Fractures and certain Deformities of the Osseous System,' Prize Essay, 1854.

<sup>2</sup> 'American Journal of the Medical Sciences,' vol. lv. 1868.

In the 'Lancet' of April, 1876, this operation of subcutaneous division of the uniting medium of the femur and the patella is claimed as a new operation, notwithstanding that it has been fully described, and repeatedly performed.

<sup>3</sup> 'North American Medical and Surgical Journal,' 1827.

so that the thigh was flexed, and the knee was carried across the opposite thigh.

Twenty months after the accident, Barton performed his operation for an artificial joint; for which he made a crucial incision over the great trochanter, seven inches in length and five in a horizontal direction. With a fine saw, he then divided the bone transversely between the two trochanters. The natural direction of the limb was immediately afterwards easily restored. At the expiration of two months, Coyle first put his foot to the ground; and after four months, not an untoward symptom having shown itself, he could walk a considerable distance, and had gained so much power and the artificial joint had become so fairly established that he could carry the foot twenty-four inches forwards, twenty-six backwards, twenty laterally, and he could rotate it six inches inwards or outwards. There was shortening of the limb to the extent of half an inch only. He died of phthisis pulmonalis, having abandoned himself to drunkenness and dissipation, and having entailed on himself, through his mode of living, an attack of inflammation in the new joint, through which ankylosis took place two years before his death.

Some few weeks after the operation the ends of the bones became smooth, rounded, and united by means of ligamentous bands; and thus an artificial joint was formed, which allowed of all the motions of the limb. This patient enjoyed the use of his artificial joint for six years.

This operation of Barton's was an admirable one, and the result, so far as it went, was excellent. There was this defect in it, however—that the section of the bone was made too far away from the original centre of motion.

The establishment of a false joint, by division of the bone immediately contiguous to the ankylosed articulation, is sometimes sufficient, without the removal of a portion of bone, to restore mobility. The bone is to be divided with a small saw, and the wound having healed, motion is to be imparted to the limb to prevent reunion. The divided ends of the bone thus become fashioned to



allow of motion, the movable end being rounded, while that which is fixed becomes expanded and slightly hollowed out into somewhat of an excavation. A kind of capsular ligament surrounds and binds together the two portions, into which is secreted a fluid very much resembling synovia, and in time the muscles accommodate themselves to the new articulation. It is important to establish the new joint as near to the destroyed articulation as possible, that the muscles may more easily resume their functions.

John Hunter, speaking of false joints, says, "When two bones rub and press on one another, absorption of the external surface takes place, the adhesive ossific inflammation goes on around the edges, a fluid is secreted in the cavity, and thus we have the new joint." And again, "The surrounding parts thicken and form a kind of capsular ligament, and the extremities of the bone rub against each other at each motion of the limb, by which stimulus the broken parts are absorbed, and the extremities become smooth, and in time are covered with something similar to cartilage, and at length the cavity between them becomes filled with a fluid very much resembling synovia."<sup>1</sup>

When it is desired to re-establish mobility, the section should be made as near as possible to the centre of the articulation, so that the power of the muscles may be diminished as little as possible. With this view I operated, in 1861, with Dr. Richard Brown, at Brighton, in a case somewhat similar to that of Dr. Barton, Mr. Braithwaite and Mr. Penfold also being present, and kindly assisting.

The case was as follows :

A young lady, twenty-five years of age, had contracted hip-joint disease when six years old. The hip was fixed at such an angle that the foot was raised five inches from the ground.

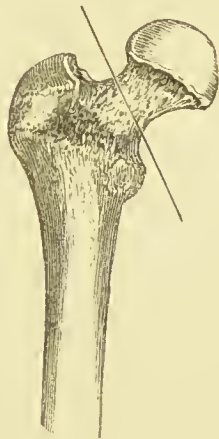
I cut through the neck of the femur immediately below the head of the bone and above the trochanter, and then gouged away some dead bone from the acetabulum. The

<sup>1</sup> 'Lectures on the Principles of Surgery,' chap. xviii.



line of the saw is shown in Fig. 4. The wound healed almost entirely by the first intention, and in three weeks it was firmly cicatrised, so that passive motion could be freely employed. In six weeks from the operation this patient began to use the limb in walking. And it is recorded that "after six months the limb could be flexed at a right angle with the trunk, and it could be freely rotated outwards. The patient could at this time sit down with ease." After two years the condition was as follows:—There was free motion at the hip-joint, and instrumental aid in walking was not needed. There was neither lateral yielding at the hip, nor was there pain. This case was related in detail in a paper<sup>1</sup> read before the Royal Medical and Chirurgical Society, March 11th, 1862, and it was illustrated by the drawing from which the accompanying woodcut, Fig. 4, was made.

FIG. 4.



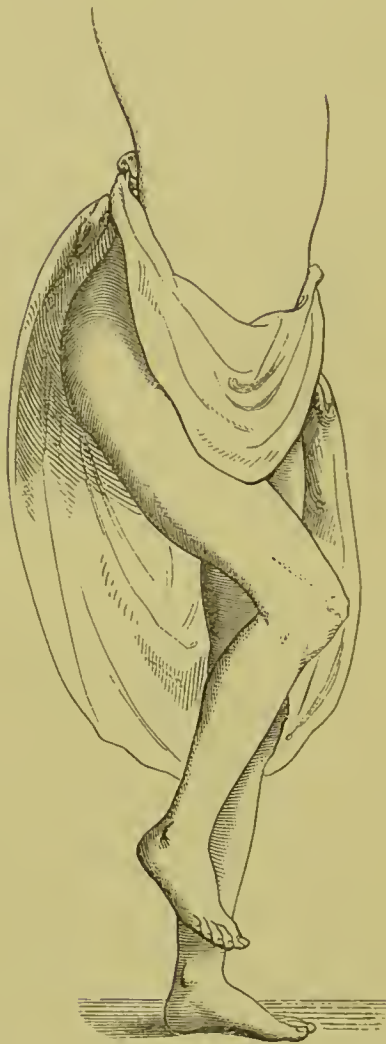
In 1864 I operated, with Dr. Risk, of Blackpool, on a patient eighteen years of age, whose right thigh was flexed upon the pelvis and was crossed over the opposite limb, so that the foot was raised four inches from the ground. The position of the limb is shown in Fig. 5.

The pelvis was much tilted and there was considerable

<sup>1</sup> "Further Remarks on Anchylosis, together with an account of a New Operation for Bony Anchylosis."

lordosis. A crutch was always used in walking. On

FIG. 5.



the 18th October, 1864, I divided the neck of the thigh-bone subcutaneously. The external incision was made by entering the knife a quarter of an inch above the great trochanter and carrying it directly upwards to the extent of one inch and a quarter. The knife was then passed down to the neck of the femur and over the bone, and on withdrawing the knife a small strong saw was passed into the wound upon it, and the serrated edge being

turned downwards towards the bone, this was divided just above the trochanter. The saw was then immediately reapplied, and a small portion of bone was removed. The wound healed by the first intention, and in six weeks this patient walked and bore some weight on the foot. There was fair motion at the hip-joint, especially of flexion and of abduction.

While the patient was still under the influence of chloroform the limb could be fully extended, and it was observed that lordosis was at the same time in great measure removed.

The wound was carefully closed, and it healed in its entire extent by the first intention. The limb was kept slightly flexed on a splint for some few days. Lordosis, which had been extreme, after six weeks existed no longer.

In January, 1877, twelve years after this operation was performed, I had the satisfaction of showing this patient at a meeting of the Clinical Society, and it was then observed that there was considerable motion of the limb, namely, of flexion, adduction, and abduction, and that the limb was strong and useful. The patient walked without artificial support of any kind.<sup>1</sup> Fig. 6 represents her at that time.

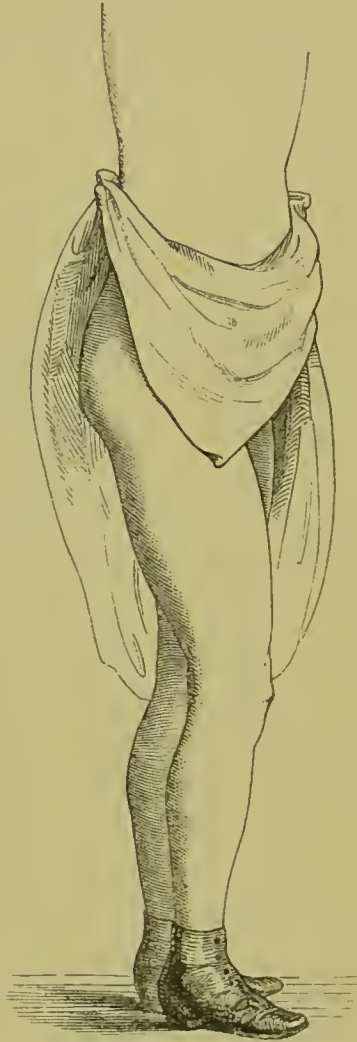
A chronic form of inflammation may be set up after these operations, whether by accident or otherwise, which may result in loss of motion, just in the same manner as in cases of fibrous ankylosis after motion has been perfectly restored. Thus, in a case on which I operated, in conjunction with Sir Duncan Gibb and Dr. Trouncer, motion at the hip-joint was perfectly restored, and my patient could walk easily and without pain or unusual fatigue. Motion was almost as free as in the other limb; when in 1867 he unfortunately fell on the ice and struck his hip. Inflammation followed, and tough adhesions were formed.

Dr. Sayre, in 1862, repeated, with a slight difference,

<sup>1</sup> 'Transactions of the Clinical Society of London,' vol. x, art. xv, p. 91.

Barton's operation. He removed a semicircular segment of bone from the femur immediately above the trochanter

FIG. 6.



minor, with a view of establishing an artificial joint. The result of the operation was that in six months the patient could stand without artificial support, and he could take a step twenty-seven inches in advance. Further, the leg could be crossed over the other below the knee, but not upon the thigh.

Again, in November, 1862, Sayre performed a second operation of a similar character. In July, 1863, he



reports—"The motions are nearly as perfect as those of the natural limb." In the following spring, having taken cold, this patient died, aged twenty-five.

The *post-mortem* examination showed that the artificial joint was "provided with a complete capsular ligament, and that the articulating surfaces were tipped with cartilage and furnished with synovial membrane." . . . "All the other parts of the head and the new acetabulum were smooth and covered with cartilage."

"The conjunction of the articulating surfaces was perfected by the formation of two round ligaments springing from the surface of the new acetabulum, and by their convergence at the same point of attachment to the new caput femoris formed a new ligamentum teres."<sup>1</sup>

4. Where it is intended only to rectify a false position of the limb, the bone may be divided subcutaneously, and an improved position may be given. I performed an operation of this character, with the assistance of Dr. Richard Brown and Mr. Potter in 1865 at Brighton; and have subsequently had many opportunities of performing these operations of subcutaneous osteotomy.

The external wound is to be made sufficiently large to admit the saw easily; and when the neck of the femur is to be operated on, the knife is to be carried down to and over the bone, and the wound is to be enlarged in withdrawing the knife, sufficiently to work the saw. Before withdrawing the knife the saw may be introduced upon it, and the serrated edge turned towards the bone. When the external wound is only sufficiently large to admit the saw, laceration takes place, and suppuration almost necessarily follows. I have never known this to occur, however, when the opening was large enough to work the saw easily. In the case of a young woman on whom I operated at St. George's Hospital,<sup>2</sup> where great deformity with bony an-

<sup>1</sup> 'A new Operation for Artificial Hip-joint in Bony Anchylosis.' Illustrated by two cases, 1863.

<sup>2</sup> 'Transactions of the Clinical Society,' vol. x, p. 92.

chylosis had resulted and where the foot was raised seven inches from the ground, I divided the neck of the femur with a small saw, having made the external opening scarcely larger than to admit the saw easily. Troublesome suppuration followed, and an abscess formed at the junction of the upper with the middle third of the thigh. Notwithstanding, the patient recovered well, and in three months walked and bore her weight on the limb. I have never known suppuration to occur where sufficient room was allowed for moving the saw. It is, therefore, desirable to make the external opening somewhat larger than is absolutely necessary for the introduction of the saw or the chisel, to avoid bruising and laceration of the soft structures in the vicinity of the bone.

I operated on the following case, together with Mr. Balkwill and Mr. Clover:—E. B.—, aged twenty-nine, had hip disease from five years of age, after sitting on the wet grass. An abscess formed, and eventually bony anchylosis took place, the knee being crossed over the opposite thigh, and the foot being raised ten inches away from the ground. The knife was introduced over the neck of the femur and the wound was enlarged to one inch in length in withdrawing the knife. The saw was introduced upon the knife, and being turned towards the bone, the neck was quickly cut through. Immediately the limb could be straightened. The wound was dressed with carbolic ointment; and in three days it was entirely healed, and the dressing was discontinued. Extension was kept up by means of weights slung over pulleys. At first full extension could not be borne; and, indeed, it was fully ten days before fourteen pounds could be borne for more than two or three hours. After this time relief was given by diminishing the weights by two or three pounds. In the course of a fortnight crutches were used, and at the end of four weeks she left London, wearing a boot and support and using a stick. Three months later while riding, her horse took fright and she was thrown to the ground.

She returned to town, and I found that beyond some unimportant bruises there was no injury.

I prefer to use weights and pulleys to draw down the limb or to abduct it, rather than to employ any form of splint. Extension is to be made from above the knee and the ankle; and for abduction from the lower part of the thigh; and the weights are suspended from movable up-rights at the lower end of or at the side of the bed, as the case may be. Lately, I operated on both femora, and applied extension in this manner. The patient was perfectly comfortable and without complaint during the whole time that it was necessary to sling her.

Also, it may be necessary in subcutaneous osteotomy to alter the direction of the saw before the section of the bone is complete. Thus, in an instance on which I operated, in every respect similar to that from which the drawing was made, which represents ankylosis of the hip-joint, the femur being fixed at an acute angle, and from which Fig. 7 was taken, it was necessary that a wedge-shaped piece of bone should be removed, so that all the advantages of the operation might be gained. Unless this were done the limb could not be extended, although the bony union might be divided. So it was necessary to remove a wedge of bone, and to extend the opening from *b* to *c*, as is shown in the plate. The operation was not, however, less subcutaneous in its character because the external wound was enlarged. If the bone to be operated on be not exposed the operation remains strictly subcutaneous.

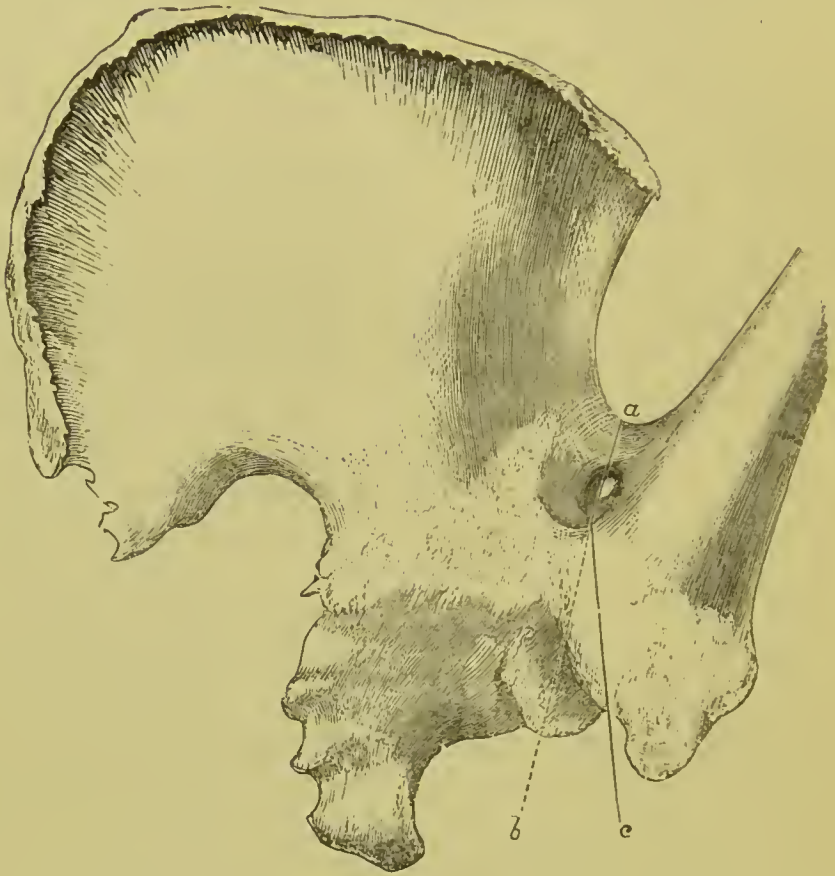
Also in another case on which I operated later in the hospital, A. B.—, and in which the angle was somewhat similar to that represented in Fig. 7, the external incision was only large enough to admit the small saw.

But whether osteotomy be subcutaneous or not does not depend entirely on the size of the wound. The wound, though comparatively large, may be so placed as to leave the operation subcutaneous. And the external wound should



always be so placed that when the operation is complete, it should not correspond to the section of the bone. The results of these operations are frequently more favorable when the external opening is somewhat larger than when

FIG. 7.



it is so small as to occasion bruising of the soft parts by the saw. Yet the external opening should not be larger than is necessary to admit and to work the saw easily. There are cases of this description where it is necessary to remove portions of dead bone, and where, consequently, the external wound must be enlarged somewhat. More injury is done by bruising the soft structures than by making a free opening; and the character of the operation may remain exactly the same, notwithstanding that the ex-



ternal wound be somewhat enlarged, so long as the parts to be divided are not exposed. If, for instance, the thigh is flexed upon the pelvis, as in the case now referred to, and it is proposed to divide the neck of the thigh-bone, the external division should be made as much beyond the division in the bone as possible, so that not only the wounds in the soft structures and in the bone shall not correspond, but when after division the limb is extended the wound in the skin shall really be remote from the section of the bone.

Mr. Gant, and the late Mr. Maunder have obtained good results by dividing the femur below the small trochanter; but there was no question of restoring mobility in any of their operations. Now, it is doubtless a great advantage to remove such deformity as is occasionally met with, such as the thigh-bone fixed at a right angle with the pelvis, or abducted or adducted in a line almost or quite horizontal. The removal of such deformity seems to leave nothing more to be desired. But, if motion at an artificial joint can be added to the removal of deformity, the triumph of surgery is yet greater. And the chances of securing this desideratum are in proportion to the near approach of the section of the bone to the joint itself.

It seems to me unnecessary to say that where the conditions are such that the neck of the bone cannot be cut through, and yet it is desired to divide the femur, the point which, of necessity, must be selected, is the line above the small trochanter. This line would, however, scarcely be selected in the first instance, for the great point of the operation is to place the section of the bone as near as possible to the centre of motion. Of course, if movement is not to be aimed at as a result of the operation, it is of small consequence whether the section be made above or below the great trochanter. But in such cases as have been brought under the notice of the profession by Mr. Jessop and by Mr. Lund, as well as those which I have recorded, it is of vital importance for the

ultimate success of the operation that the line selected shall be at the nearest available point to the centre of motion.

In the thigh-bone, therefore, where it is possible, the section should be made through the neck, for there is then more chance of producing an artificial joint, and especially there is more chance that it shall be permanent, than when the shaft is divided.

Subcutaneous osteotomy, although done now and again in Germany, in America, and in England, scarcely became a well-recognised operation until Mr. Adams, having divided the neck of the femur in a case of fibrous ankylosis, especially directed attention to the subject.<sup>1</sup>

At the hip, then, an artificial joint may be made or the limb may simply be straightened after cutting through the bone; while at the elbow or at the knee, when osseous ankylosis has taken place at a faulty angle, either a wedge of bone may be removed or subcutaneous drilling through the uniting medium may be practised, or this may be cut through with the chisel.

When a subcutaneous operation can be done it will, of course, be selected in preference to an open wound as for the removal of a wedge of bone; but in long-standing ankylosis, and when fusion has occurred, perforation may not be possible. No choice will then remain to the operator. Under such circumstances, if angular osseous ankylosis at the knee is to be removed and the limb is to be straightened, nothing remains to be done that is worthy of consideration but to take away a wedge of bone sufficiently large to allow of the straightening of the limb. And also of the elbow, when the arm has been kept straight and useless, under similar circumstances, on removing a wedge of bone a convenient angle can be given.

The disruption of the weakened bone-substance after perforation is, in one case and the other, easy and free

<sup>1</sup> 'A New Operation for Bony Ankylosis of the Hip-joint, with Malposition of the Limb,' 1871.

from danger if done in flexing the limb. It is only when violence is employed in extension of the limb that it is hazardous. After disruption is complete the limb is to be placed on a splint at the same angle as before the operation, and after some few days gradual extension may commence and be carried on slowly, the flexors of the leg or the extensor tendon above the elbow being divided, should they in the slightest degree, as probably they will, interfere with the treatment.

When bony anchylosis of the maxilla has taken place, either by fusion, or by a bridge of bone extending from the lower maxilla to the temporal bone (for these osseous bands not unfrequently follow the course of the ligaments), it is necessary to divide the ramus of the jaw. Whenever it becomes necessary to divide the ramus care must be taken so to divide it that the false joint shall be formed in front of the impediment to motion, whatever this may be; otherwise the operation will be useless. When, however, the operator has the choice of position, it is well to select the sigmoid notch: less injury is inflicted in this position, and more power remains to the patient. I have only once seen a case in which bony anchylosis had taken place simultaneously on both sides of the jaw. This resulted as a sequence of gonorrhœal rheumatism.

Prof. Rizzoli<sup>1</sup> has recorded a case which is exceedingly instructive, and which, therefore, I allude to.

L. V—, æt. 23, had pain and swelling at the angle of the jaw; abscess formed and emptied itself near the last molar tooth. The swelling subsided, and there remained stiffness of the jaw, the movements of which became more and more difficult, until, at length, they ceased entirely. After eight years she was admitted into hospital. It was found that dense cicatrices had formed in front of the angle of the jaw. These were divided, and the knife was carried down to the lower border of the maxilla to expose the bone. The ramus of the jaw was then divided with the cutting pliers. A false joint

<sup>1</sup> 'Op. cit.

was established, so that the mouth could be opened wide, and she was able to masticate her food, and was able to eat, drink, speak, and laugh as in her normal condition.



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# INDEX TO J. & A. CHURCHILL'S CATALOGUE.

- Acton's Reproductive Organs, 5  
 Adams (W.) on Clubfoot, 4  
 ——— Contraction of the Fingers, 4  
 Allan on Fever Nursing, 10  
 Allingham on Diseases of the Rectum, 5  
 Anatomical Remembrancer, 7  
 Anderson (McC.) on Eczema, 12  
 Aveling's Influence of Posture on Women, 9  
 Bantock on Rupture of the Perineum, 9  
 Barclay's Medical Diagnosis, 7  
 Barnes on Obstetric Operations, 9  
 ——— on Diseases of Women, 9  
 Beale's Microscope in Medicine, 7  
 ——— Slight Ailments, 7  
 Bellamy's Surgical Anatomy, 6  
 Bennet (J. H.) on Winter and Spring on the Shores of  
 the Mediterranean, 11  
 ——— on Pulmonary Consumption, 11  
 ——— on Nutrition in Health and Disease, 12  
 Bentley and Trimen's Medicinal Plants, 8  
 Berkart on Asthma, 10  
 Bigg (H. H.) on Orthopraxy, 4  
 Bigg (R. H.) on the Orthopragms of Spine, 4  
 Binz's Elements of Therapeutics, 8  
 Black on the Urinary Organs, 5  
 Bose's Rational Therapeutics, 8  
 ——— Recognisant Medicine, 8  
 Braune's Topographical Anatomy, 7  
 Brodhurst's Orthopædic Surgery, 4  
 Bryant's Practice of Surgery, 3  
 Bucknill and Tuke's Psychological Medicine, 13  
 Burdett's Cottage Hospitals, 10  
 ——— Pay Hospitals, 10  
 Burnett on the Ear, 4  
 Burton's Midwifery for Midwives, 8  
 Buzzard's Syphilitic Nervous Affections, 6  
 Carpenter's Human Physiology, 6  
 Carter (W.) on Renal Diseases, 5  
 Cayley's Typhoid Fever, 8  
 Charteris' Practice of Medicine, 7  
 Clark's Outlines of Surgery, 4  
 Clay's Obstetric Surgery, 9  
 Cobbold on Parasites, 12  
 Coles' Dental Mechanics, 14  
 Cormack's Clinical Studies, 7  
 Coulson on Stone in the Bladder, 5  
 ——— on Syphilis, 5  
 ——— on Diseases of the Bladder, 5  
 Cripps' Cancer of the Rectum, 5  
 Cullingworth's Nurse's Companion, 9  
 Curling's Diseases of the Testis, 5  
 Dagueuet's Manual of Ophthalmoscopy, 14  
 Dalby's Diseases and Injuries of the Ear, 4  
 Dalton's Human Physiology, 6  
 Day on Headaches, 11  
 Dobell's Lectures on Winter Cough, 10  
 ——— Loss of Weight, &c., 10  
 Domville's Manual for Nurses, 9  
 Druitt's Surgeon's Vade-Mecum, 3  
 Duncan on the Female Perineum, 9  
 ——— on Diseases of Women, 9  
 Dunglison's Medical Dictionary, 14  
 Ellis's Manual for Mothers, 8  
 Emmet's Gynæcology, 9  
 Eulenburg and Guttman's Sympathetic System of  
 Nerves, 12  
 Fayrer's Observations in India, 4  
 Fergusson's Practical Surgery, 3  
 Fenwick's Atrophy of the Stomach, 7  
 ——— Medical Diagnosis, 7  
 ——— Outlines of Medical Treatment, 7  
 Flint on Phthisis, 10  
 ——— on Clinical Medicine, 10  
 Flower's Diagrams of the Nerves, 7  
 Foster's Clinical Medicine, 7  
 Fox (C. B.) Sanitary Examinations of Water, Air, and  
 Food, 13  
 Fox (T.) Atlas of Skin Diseases, 12  
 Frey's Histology and Histo-Chemistry, 6  
 Fulton's Text-Book of Physiology, 6  
 Galabin's Diseases of Women, 9  
 Gamgee's Fractures of the Limbs, 3  
 ——— Treatment of Wounds, 3  
 Gant's Diseases of the Bladder, 5  
 Gaskoin on Psoriasis or Lepra, 12  
 Glenn's Laws affecting Medical Men, 12  
 Godlee's Atlas of Human Anatomy, 7  
 Gowers' Diseases of the Spinal Cord, 13  
 ——— Medical Ophthalmoscopy, 13  
 ——— Pseudo-Hypertrophic Muscular Paralysis, 13  
 Habershon's Diseases of the Abdomen, 11  
 ——— Diseases of the Stomach, 11  
 ——— Pneumogastric Nerve, 11  
 Hamilton's Nervous Diseases, 12  
 Hardwicke's Medical Education, 14  
 Harris on Lithotomy, 5  
 Harrison's Surgical Disorders of the Urinary Organs, 5  
 Heath's Diseases and Injuries of the Jaws, 3  
 ——— Minor Surgery and Bandaging, 3  
 ——— Operative Surgery, 3  
 ——— Practical Anatomy, 7  
 ——— Surgical Diagnosis, 3  
 Higgens' Ophthalmic Out-patient Practice, 14  
 Hogg's Indian Notes, 11  
 Holden's Dissections, 6  
 ——— Human Osteology, 6  
 ——— Landmarks, 6  
 Holmes (G.) Vocal Physiology and Hygiene, 11  
 Hood on Gout, Rheumatism, &c., 12  
 Horton's Tropical Diseases, 11  
 Hutchinson's Clinical Surgery, 3  
 ——— Rare Diseases of the Skin, 12  
 Huth's Marriage of Near Kin, 5  
 Ireland's Idiocy and Imbecility, 13  
 Irvine's Relapse of Typhoid Fever, 8  
 James on Sore Throat, 10  
 Jones' (C. H.) Functional Nervous Disorders, 11  
 Jones (C. H.) and Sieveking's Pathological Anatomy, 6  
 Jones' (H. McN.) Aural Surgery, 4  
 ——— Atlas of Diseases of Membrana Tympani, 4  
 Jones' (T. W.) Ophthalmic Medicine and Surgery, 14  
 Jordan's Surgical Enquiries, 4  
 Lancereaux's Atlas of Pathological Anatomy, 6  
 Lane's Lectures on Syphilis, 5  
 Lee (H.) on Syphilis, 5  
 Leared on Imperfect Digestion, 12  
 Liebreich's Atlas of Ophthalmoscopy, 14  
 Liveing's Megrin, Sick-headache, &c., 12  
 Lucas's Indian Hygiene, 11  
 Macdonald's (A.) Chronic Disease of the Heart, 10  
 Macdonald's (J. D.) Microscopical Examination of  
 Water, 13  
 Macewen's Osteotomy: Knock-knee, Bow-leg, &c., 4  
 Mackenzie on Diphtheria, 10  
 ——— Diseases of the Throat and Nose, 4  
 MacLise's Dislocations and Fractures, 7  
 ——— Surgical Anatomy, 7  
 MacMunn's Spectroscope in Medicine, 6  
 Macnab's Medical Account Books, 14  
 Macnamara's Diseases of the Eye, 14  
 Madden's Principal Health Resorts, 11  
 Marsden on Cancer, 12  
 Mason on Hare-Lip and Cleft Palate, 4  
 ——— on Surgery of the Face, 4  
 Mayne's Medical Vocabulary, 14  
 Mitchell on Cancer Life, 12  
 Moore's Family Medicine for India, 11  
 Morris' (H.) Anatomy of the Joints, 7  
 Nettleship's Diseases of the Eye, 14  
 Ogston's Medical Jurisprudence, 13  
 Osborn on Diseases of the Testis, 5  
 ——— on Hydrocele, 5  
 Parkes' Practical Hygiene, 13  
 Pavy on Diabetes, 12  
 ——— on Food and Dietetics, 12  
 Peacock's Prognosis in Valvular Disease, 10  
 Phillips' Materia Medica, 8  
 Pirrie's Principles and Practice of Surgery, 3  
 Pollock on Rheumatism, 12  
 Pridham on Asthma, 10  
 Radford's Cæsarean Section, 9  
 Ramsbotham's Obstetrics, 8  
 Reynolds' (J. R.) Clinical Electricity, 13  
 Reynolds' (J. J.) on the Diseases of Women, 9  
 Roberts' (C.) Manual of Anthropometry, 6  
 Roberts' (D. Lloyd) Midwifery, 8  
 Roth on Dress: Its Sanitary Aspect, 13  
 Roussel's Transfusion of Blood, 4  
 Routh's Infant Feeding, 8  
 Royle and Harley's Materia Medica, 8

*[Continued on the next page.]*

INDEX TO J. & A. CHURCHILL'S CATALOGUE—*continued*.

- Rutherford's Practical Histology, 6  
 Sanderson's Physiological Handbook, 6  
 Sansom's Diseases of the Heart, 10  
     — Antiseptic System, 10  
 Savage on the Female Pelvic Organs, 4  
 Sayre's Orthopædic Surgery, 4  
 Schroeder's Manual of Midwifery, 9  
 Sewill's Dental Anatomy, 14  
 Sheppard on Madness, 12  
 Sibson's Medical Anatomy, 7  
 Sieveking's Life Assurance, 12  
 Smith (E.) Wasting Diseases of Children, 8  
     — Clinical Studies, 8  
 Smith (Henry) Surgery of the Rectum, 5  
 Smith (Heywood) Gynæcology, 9  
 Smith (Priestley) on Glaucoma, 14  
 Smith (W. R.) on Nursing, 9  
 Sparks on the Riviera, 11  
 Squire's Companion to the Pharmacopœia, 8  
     — Pharinacopœia of London Hospitals, 8  
 Stillé and Maisch's National Dispensary, 8  
 Stocken's Dental Materia Medica, 8  
 Sullivan's Tropical Diseases, 11  
 Swain's Surgical Emergencies, 3  
 Swayne's Obstetric Aphorisms, 9  
 Taft's Operative Dentistry, 14  
 Taylor's Medical Jurisprudence, 13  
     — Poisons in relation to Medical Jurisprudence, 13  
 Teale's Dangers to Health, 13  
 Thomas on Ear and Throat Diseases, 4  
 Thompson's (Sir H.) Calculous Disease, 5  
     — Diseases of the Urinary Organs, 5  
     — Diseases of the Prostate, 5  
     — Lithotomy and Lithotrity, 5  
 Thompson's (Dr. H.) Clinical Lectures, 7  
 Thornton on Tracheotomy, 10  
 Thorowgood on Asthma, 10  
     — on Materia Medica, 8  
 Thudichum's Pathology of the Urine, 6  
 Tibbitts' Medical Electricity, 13  
     — Map of Motor Points, 13  
 Tilt's Change of Life, 9  
     — Uterine Therapeutics, 9  
 Tomes' (C. S.) Dental Anatomy, 14  
     — (J. & C. S.) Dental Surgery, 14  
 Van Buren on the Genito-Urinary Organs, 6  
 Veitch's Handbook for Nurses, 9  
 Virchow's Post-mortem Examinations, 7  
 Wagstaffe's Human Osteology, 6  
 Walker's Ophthalmology, 14  
 Walton's Diseases of the Eye, 14  
 Waring's Indian Bazaar Medicines, 11  
     — Practical Therapeutics, 8  
 Waters' (A. T. H.) Diseases of the Chest, 10  
 Waters (J. H.) on Fits, 11  
 Wells (Spencer) on the Ovaries, 9  
 West and Duncan's Diseases of Women, 9  
 Whistler's Syphilis of the Larynx, 10  
 Whittaker's Primer on the Urine, 5  
 Wilks' Diseases of the Nervous System, 12  
 Wilks and Moxon's Pathological Anatomy, 6  
 Wilson's (E.) Anatomists' Vade-Mecum, 7  
     — Lectures on Dermatology, 12  
 Wilson's (G.) Handbook of Hygiene, 13  
     — Healthy Life, Dwellings, &c., 13  
 Wilson's (W. S.) Ocean as a Health Resort, 10  
 Woodman and Tidy's Forensic Medicine, 13

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